GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

Date: January 9, 1980

Project Title: Positive Guidance Demonstration Project

Project No: E-20-603

Project Director: Dr. P.S. Parsonson

Sponsor: Georgia Department of Transportation

Agreement Period: From 12/1/79 Until ~~11/30/80~~ 2/28/81

Type Agreement: GDOT No. PR PGDP(1) Cobb

Amount:	$27,015.85	E-20-603
	26,404.15	G-42-633 (Sub Project)
	$53,420.00	Total

Reports Required: Final Report

Sponsor Contact Person (s):

Technical Matters

Contractual Matters
(thru OCA)

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Sub project
G 42-633

Defense Priority Rating: N/A

Assigned to: C.E. (School/~~Laboratory~~)

COPIES TO:

- Project Director
- Division Chief (EES)
- School/Laboratory Director
- Dean/Director—EES
- Accounting Office
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- Project File (OCA)
- Project Code (GTRI)
- Other

B440 #33

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION

Date: 6/8/81

Project Title: Positive Guidance Demonstration Project

Project No: E-20-603

Project Director: Dr. P. S. Parsonson

Sponsor: Ga. Department of Transporation

Effective Termination Date: 2/28/81

Clearance of Accounting Charges: 2/28/81

Grant/Contract Closeout Actions Remaining:

- x Final Invoice ~~and Closing Documents~~
- _ Final Fiscal Report
- _ Final Report of Inventions
- _ Govt. Property Inventory & Related Certificate
- _ Classified Material Certificate
- _ Other ______________

Subproject is G-41-633

Assigned to: Civil Engineering (School/Laboratory)

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- Project Code (GTRI)
- Other ______________

CA–4 (1/79)

E 20-603

GDOT Contract No. PR PGDP (1) Cobb

Final Report

POSITIVE GUIDANCE DEMONSTRATION PROJECT

by

Peter S. Parsonson
Associate Professor
School of Civil Engineering
and
Edward J. Rinalducci
Professor
School of Psychology

Contract with

Department of Transportation
State of Georgia

In cooperation with

U.S. Department of Transportation
Federal Highway Administration

April 14, 1981

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF CIVIL ENGINEERING
ATLANTA, GEORGIA 30332

GDOT Contract No. PR PGDP (1) Cobb

Final Report

POSITIVE GUIDANCE DEMONSTRATION PROJECT

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Associate Professor
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Georgia Institute of Technology

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GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332

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CIVIL ENGINEERING

TELEPHONE:
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April 15, 1981

Mr. Archie C. Burnham, Jr.
State Traffic & Safety Engineer
Georgia D.O.T.
2 Capitol Square
Atlanta, Georgia

Dear Mr. Burnham:

GDOT Contract No. PR PGDP(1) Cobb
Positive Guidance Demonstration Project

I am pleased to transmit herewith the original and one copy of the Final Report for the subject project.

Yours very truly,

Peter S. Parsonson
Project Director

xc: Dr. E.J. Rinalducci
Co-Project Director
School of Psychology

Office of Contract Admin.
Georgia Tech

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ACKNOWLEDGEMENTS

The authors are grateful to Donald Mills of the Georgia DOT, and Harold Lunenfeld of the Federal DOT for their advice and assistance on this project. Mr. Mills is the project monitor for the GDOT.

The Graduate Student Assistants on this project were Juan Morales of the School of Civil Engineering and Rhea Eskew of the School of Psychology. They were assisted by undergraduate student personnel too numerous to mention.

The authors are grateful to Dorres Tharpe for typing this manuscript.

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INTRODUCTION

The purpose of this demonstration project is to utilize the Positive-Guidance procedure to analyze a railroad-highway at-grade crossing with apparent motorist-information deficiencies; determine and implement solutions; and evaluate the effectiveness of both the solutions and the Positive Guidance procedure.

This Final Report documents all of the Positive Guidance procedures followed. The site was evaluated in its substandard (as-is) condition and again after upgrading to the standards of the Manual on Uniform Traffic Control Devices (MUTCD). (The crossing is on a minor county road, not on the State system). The report explains how the project staff arrived at a Positive Guidance solution for the crossing. The solution was implemented and evaluated. All three levels of operation are compared herein for effectiveness.

Concept and Positive Guidance

Positive Guidance is a set of rational steps to provide drivers sufficient information where they need it and in the form that they can best use to avoid hazards. It combines the highway engineering and human factors technologies to produce an information system matched to the facility characteristics and driver attributes. Positive Guidance provides high payoff, short-range solutions to safety and operational problems at relatively low cost.

The Positive Guidance procedure consists of six major functions. The first three are data collection at problem locations, specifications of problems, and definition of driver performance factors. They are known as Functions A, B and C, and they relate primarily to problem definition and analysis. The next two, Functions D and E, define information requirements and determine positive guidance information. They relate to design. Finally, Function F--evaluation--provides the means to determine the effectiveness of the solutions.

The tasks of this Positive Guidance demonstration project track the standard procedures set forth in the User's Guide to Positive Guidance published by the Federal Highway Administration (FHWA) in June, 1977 (1) and in subsequent updates.

Nationwide Demonstration Projects

Congress has appropriated funds to demonstrate the application of the Positive Guidance procedure in a variety of highway situations in several states. For example, California is performing a project related to guide signing at freeway interchanges. This project in Georgia is the only one pertaining to railroad crossings.

Purpose and Scope of Project

This demonstration project enables the principles of Positive Guidance to be applied and tested at a single railroad-highway at-grade crossing that currently has no active grade-crossing devices. That is, there are no train-activated gates, lights and bells; the motorist is supposed to stop, look and listen at this crossing. Characteristically, motorists approaching this type of crossing appear to be generally complacent and to pay inadequate attention to the task of determining whether trains are approaching. This is particularly true for local-area motorists who negotiate a particular crossing very often. (The problem is compounded if trains usually arrive on a known schedule, as the drivers develop an expectancy that may not always be met.) The problems associated with inattentive local motorists are central to this demonstration project. The purpose of it is to utilize the Positive Guidance procedure to analyze the motorist-information deficiencies, determine and implement solutions, and evaluate the effectiveness of both the solutions and the Positive-Guidance procedure. It is desired to determine if the procedure is workable, and to arrive at field-tested schemes for evaluation that can be recommended to other agencies desiring to use the Positive Guidance system at railroad crossings.

The major driver-performance parameters to be measured are driver reaction. It was anticipated during the planning of the project that activated movie cameras and/or video tapes, along with manual observation, would be the devices utilized to record these reactions. Drivers' head movements might be recorded along with other reactions such as brake applications, erratic maneuvers, changes in speed, etc. Early in the project it was found that the use of several pairs of tapeswitches is preferable to cameras for obtaining speed profiles of motorists approaching the tracks. A radar gun was also used by a hidden observer to obtain the minimum speed of the vehicle at the crossing. Driver head movements, and the proximity of stopping motorists to the tracks, were obtained by hidden observers.

The field data were collected continously from 7:00 a.m. to 6:00 p.m. for at least four days for each level of improvement described below. These four days included a Saturday, a Sunday, and two normal weekdays.

At the outset of the project it was planned to demonstrate five levels of motorist information, as follows:

Level 1. As-Is Condition. The selected site is not on the State Highway System and does not comply with the MUTCD in several important respects. Driver performance data would be collected before any improvement.

Level 2. Upgraded to MUTCD standards. Once the required signs and markings were installed, then a 30-day acclimation period would be allowed for the novelty effect to wear off. Driver performance would then be collected and analyzed again.

Level 3. A Positive Guidance Solution. The Positive Guidance analysis in Functions B, C, D and E was anticipated to suggest a solution that goes beyond the requirements of the MUTCD. It could be a passive device intended to grab the attention of the approaching motorist and induce him or her to slow down comfortably, stop safely, and look both ways for a train.

Level 4. Radio Communication. It was anticipated that the Positive Guidance analysis of Functions B, C. D and E would support the demonstration of on-line communications devices such as highway advisory radio and CB radio. After the project was underway, however, the GDOT decided that the predominantly local drivers would not feel the need to use radio communications at this familiar crossing. They might try it once as a novelty, and then would ignore it. Therefore the GDOT determined that this level would not be included in the scope of the project.

Level 5. Gates, Lights and Bells. Subsequent to the completion of the work at levels 1, 2 and 3 the GDOT will install gates, lights and bells. Driver-performance data will again be collected and analyzed.

The Positive Guidance procedures consist of Functions A through F, as explained briefly in the Introduction. The next sections of the report detail these functions and present the findings.

FUNCTION A--COLLECTION OF DATA

The activities of Function A include a review of historical data, a site survey and operations review, the collection of driver performance data and the preparation of a site file describing location characteristics.

Review of Historical Data (A-1)

This activity includes obtaining a drawing of the site; analyzing accident records; analyzing traffic data; examining complaint files; and reviewing special studies and other sources.

Drawing of site. Figure 1 is a map showing the railroad-highway at-grade crossing. The site, located northwest of Atlanta in Cobb County, is an 18-foot-wide, rural two-lane road that crosses the L & N Railroad with poor sight distance from both of the roadway approaches. The Stanley Road crossing is designated number 340403B in GDOT records. The L & N milepost number is KM 446.10. Inasmuch as the railroad links Chattanooga and Atlanta, a predominantly north-south connection, the railroad is herein referred to as north-south and Stanley Road as east-west.

The photos comprising Figure 2 show that before any improvement the crossing had warning and protective devices consisting of two STOP signs, one STOP AHEAD sign, and a wood crossbuck facing in both directions. The side road parallel to the track, identified as Line Road in Figure 1, leads to a nearby boarding school for emotionally disturbed children.

Figures 3 and 4 give further indication of the sight-distance restrictions due to fences, trees and hillocks in the four quadrants of the crossing. These figures also show the stations of the hidden observers who collected performance data during the project.

Figure 1. Map of Site

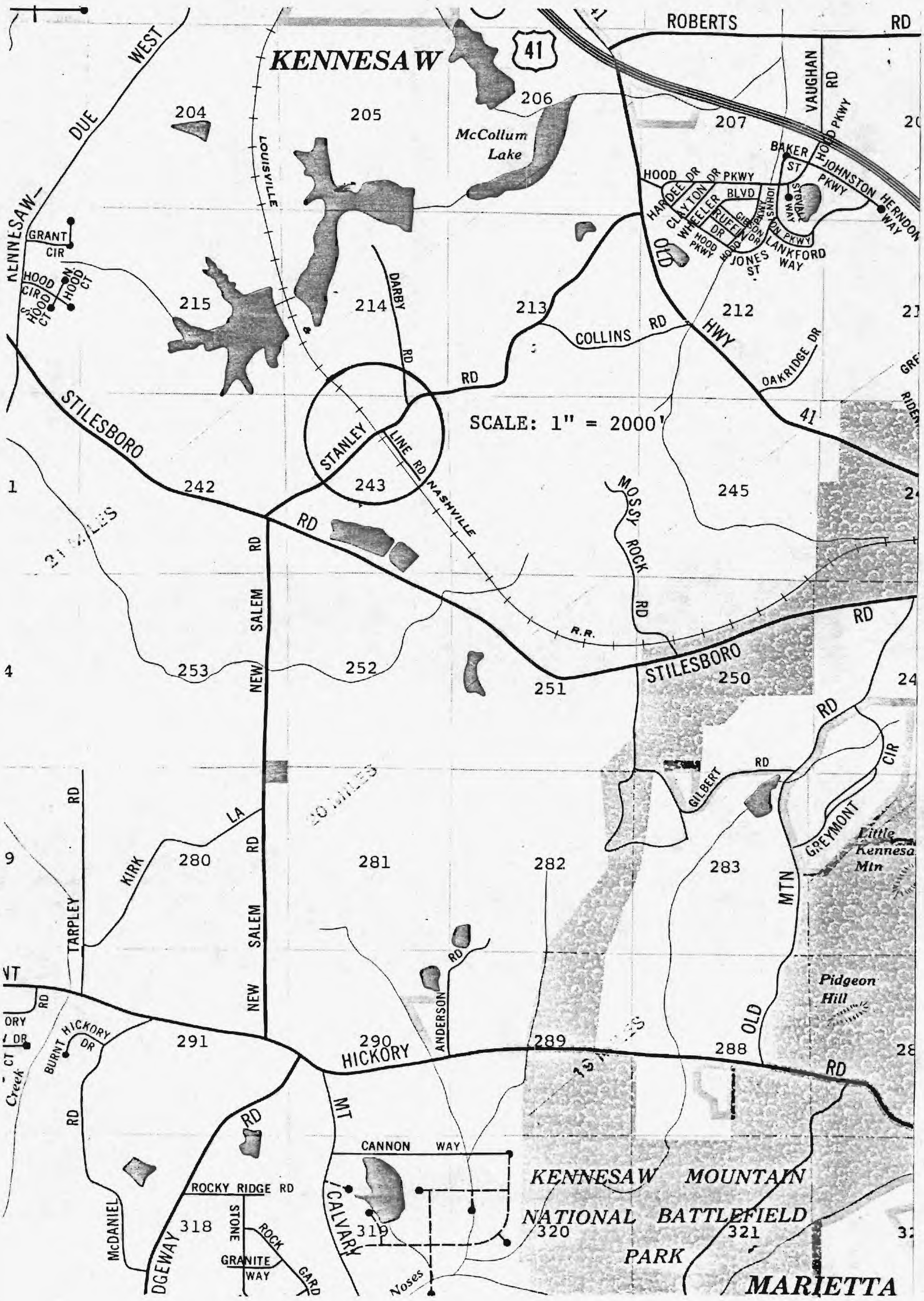
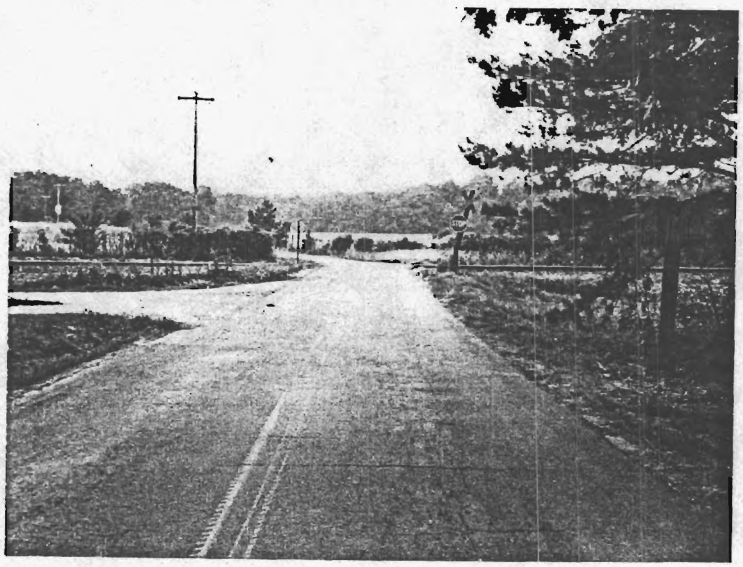


Figure 2. Photos of site in Level 1 (as-is) condition



2 a. Approach From Northeast, 150 feet From Track
Sign at Far Right, 110' Back, says GEORGIA LAW, STOP, UNSAFE RR CROSSIN

2 b. Approach From Northeast, 300 feet From Track

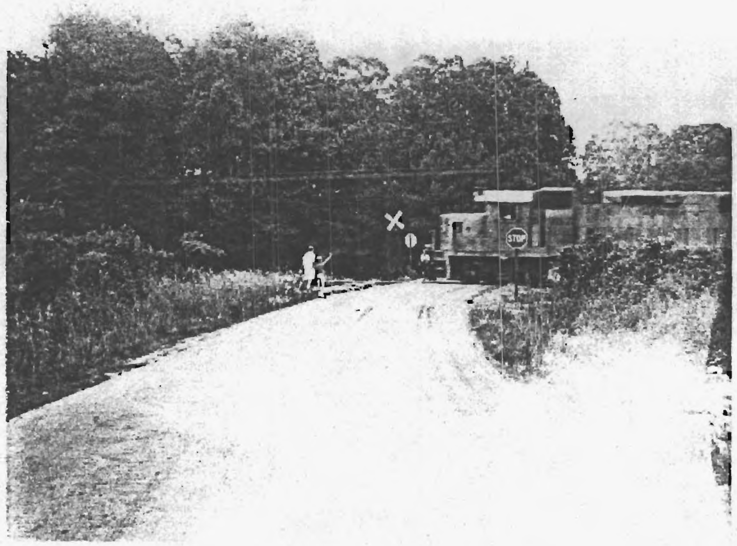
Stanley Road, Cobb County, at L&N Railroad Crossing, 6/20/79, 3:00pm

2 c.. Approach From Northeast, 450 feet From Track

2 d. Approach From Northeast, 600 feet From Track

Stanley Road, Cobb County, at L&N Railroad Crossing, 6/20/79, 3:00pm

2 e. Approach from Southwest, 140 feet From Track



2 f. Approach from Southwest, 140 feet From Track

Stanley Road, Cobb County, at L&N Railroad Crossing, 6/20/79, 3:00pm

2 g. Approach From Southwest, 300 feet From Track

2 h. Approach From Southwest, 600 feet From Track

Stanley Road, Cobb County, at L&N Railroad Crossing, 6/20/79, 3:00pm

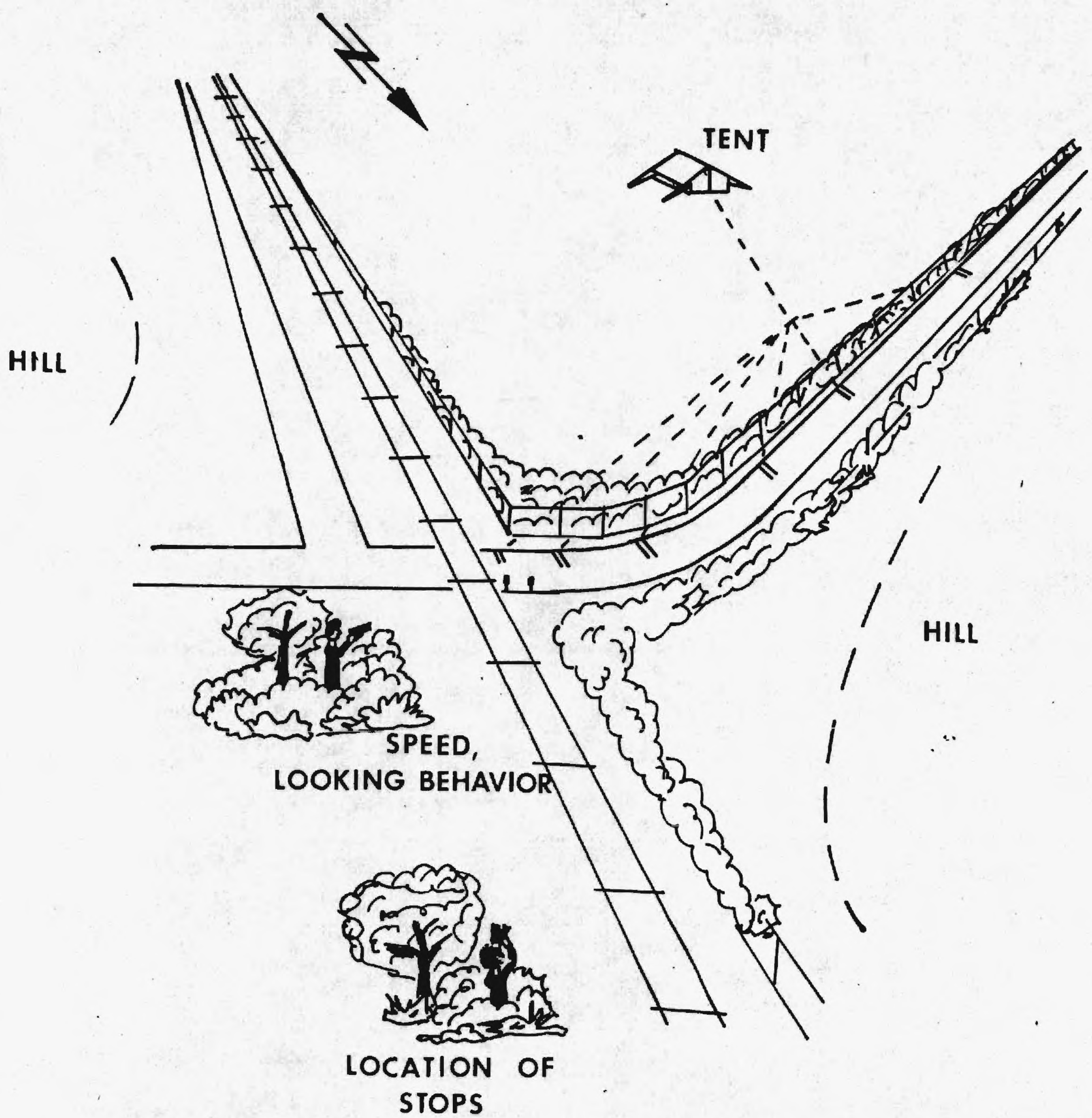


Figure 3. Sketch of west (eastbound) approach

Figure 4. Sketch of east (westbound) approach

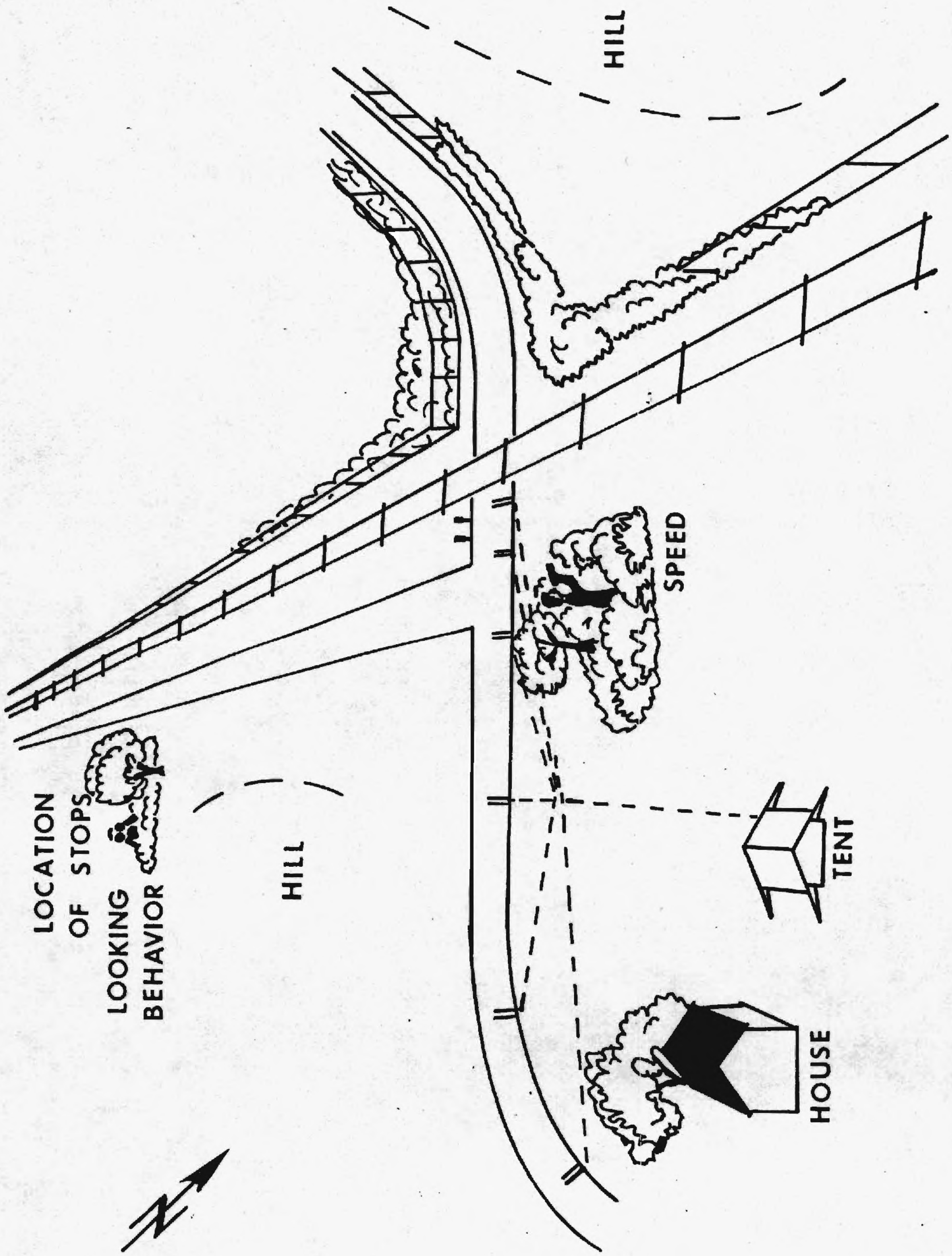


Figure 5, a sight-distance graph, shows that the west approach is particularly restricted because of the high fences and the abrupt curve just before the crossing.

If a motorist does stop at the crossing, visibility to the south along the tracks is excellent. To the north it is adequate.

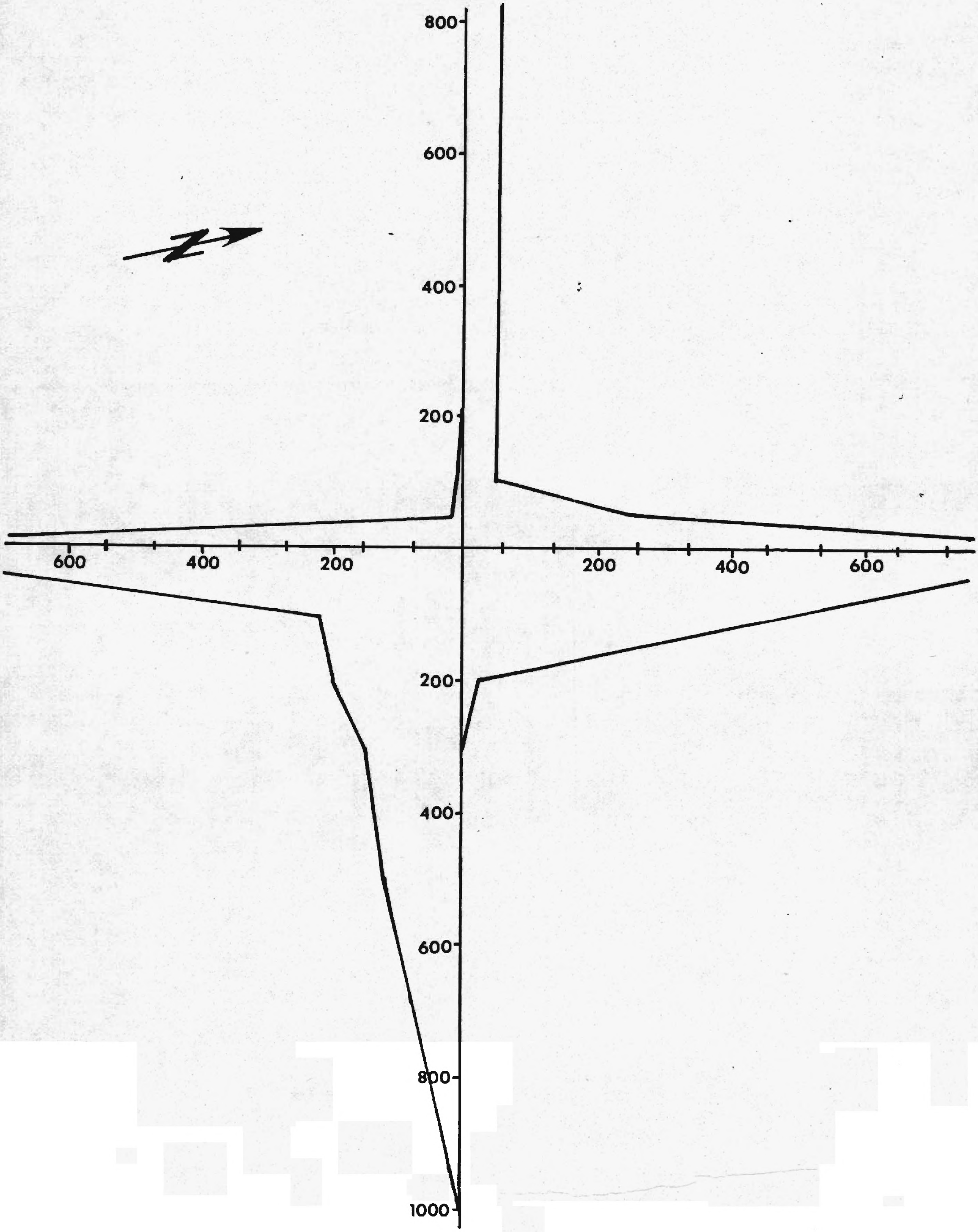
Accident Records. Cobb County records show no accidents at this site, but special studies described below indicate that the location is hazardous and overdue for a serious accident.

Traffic Data. Stanley Road has an ADT of 1100 vehicles per day and is used only by motorists with trip origins or destinations along the road, and by other local drivers who realize that Stanley Road offers a convenient shortcut between Old Highway 41 and Stilesboro Road. Although the site is not far from the popular Kennesaw Mountain National Battlefield Park, tourists and sightseers do not use Stanley Road. The speed limit is 35 miles per hour and is self-enforcing because of the winding curvature of most of the length of the road.

The crossing is used by one or two Cobb County school buses twice a day.

The crossing averages 37 trains per day, of which about half arrive during daylight hours. Approximately two-thirds of the trains operate on a regular schedule, but 12 or 13 trains per day arrive at unscheduled times. Furthermore, during 1980 the tracks from Atlanta to Chattanooga were being rebuilt, creating a need to postpone the departure of many trains scheduled for working hours. As a result, arrivals are entirely unpredictable. Train speed is widely variable from 5 to 30 mph, depending on the display of the block signals.

Figure 5. Sight-distance graph



Complaint Files. Cobb County has received no complaints in the past five years. However, the GDOT is aware of a decision by a married couple, who commute to Atlanta, not to use this route for their work trips because of the perceived danger.

Special Studies. The Peabody-Dimmick formula, used by the GDOT, indicates a Hazard Index of 8.38. This is high when it is considered that crossings having indices of only 5 to 6 are currently receiving active warning devices in the form of gates, bells and lights.

GDOT personnel feel that the local residents using the crossing are so accustomed to it that they are lulled into an attitude of complacency. They lack respect for the danger. Often a vehicle is almost on the tracks by the time it stops, it was felt. It is the classic problem of the inattentive local motorist.

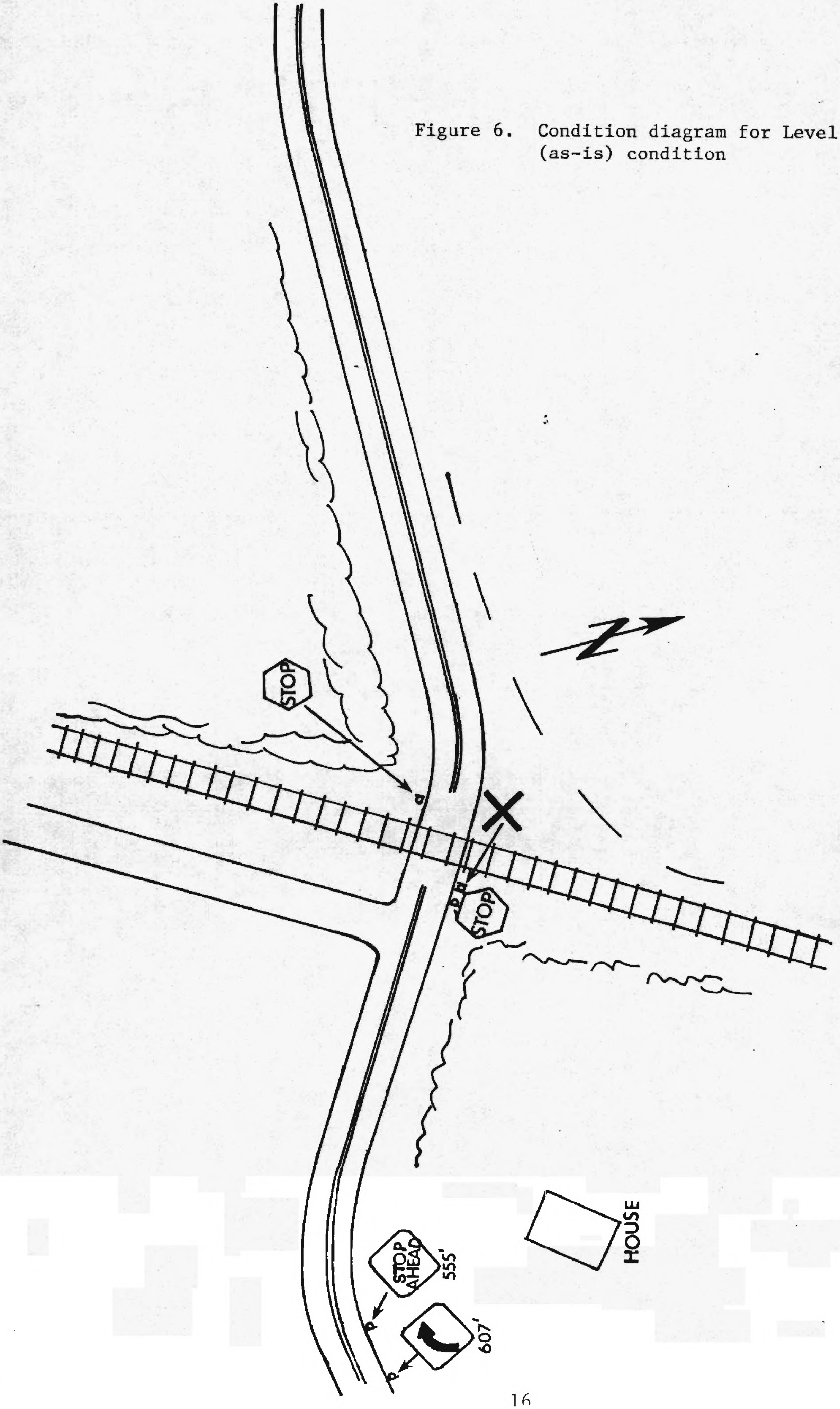
Site Survey and Operations Review (A-2)

This activity includes the drive-through by project personnel in a "floating" vehicle, and the observation of traffic operation.

Site Survey (Drive-Through). Motion pictures (16 mm), color slides, and black-and-white prints were obtained over 1000 feet of each approach, for both the Level 1 (as-is) condition and the Level 2 condition (Upgraded to MUTCD standards). Figures 6 and 7 show to scale the details of the markings and signs for these two levels. Figure 8 is a collection of photographs taken after upgrading the site to MUTCD standards.

Observation of Operations. Driving eastbound on the west approach to the crossing, it is noticeable that the road is straight for almost 1000 feet and then bends to the right just before the crossing. The driver's view of the track and its trains is obstructed by high fences overgrown with vines.

Figure 6. Condition diagram for Level 1 (as-is) condition



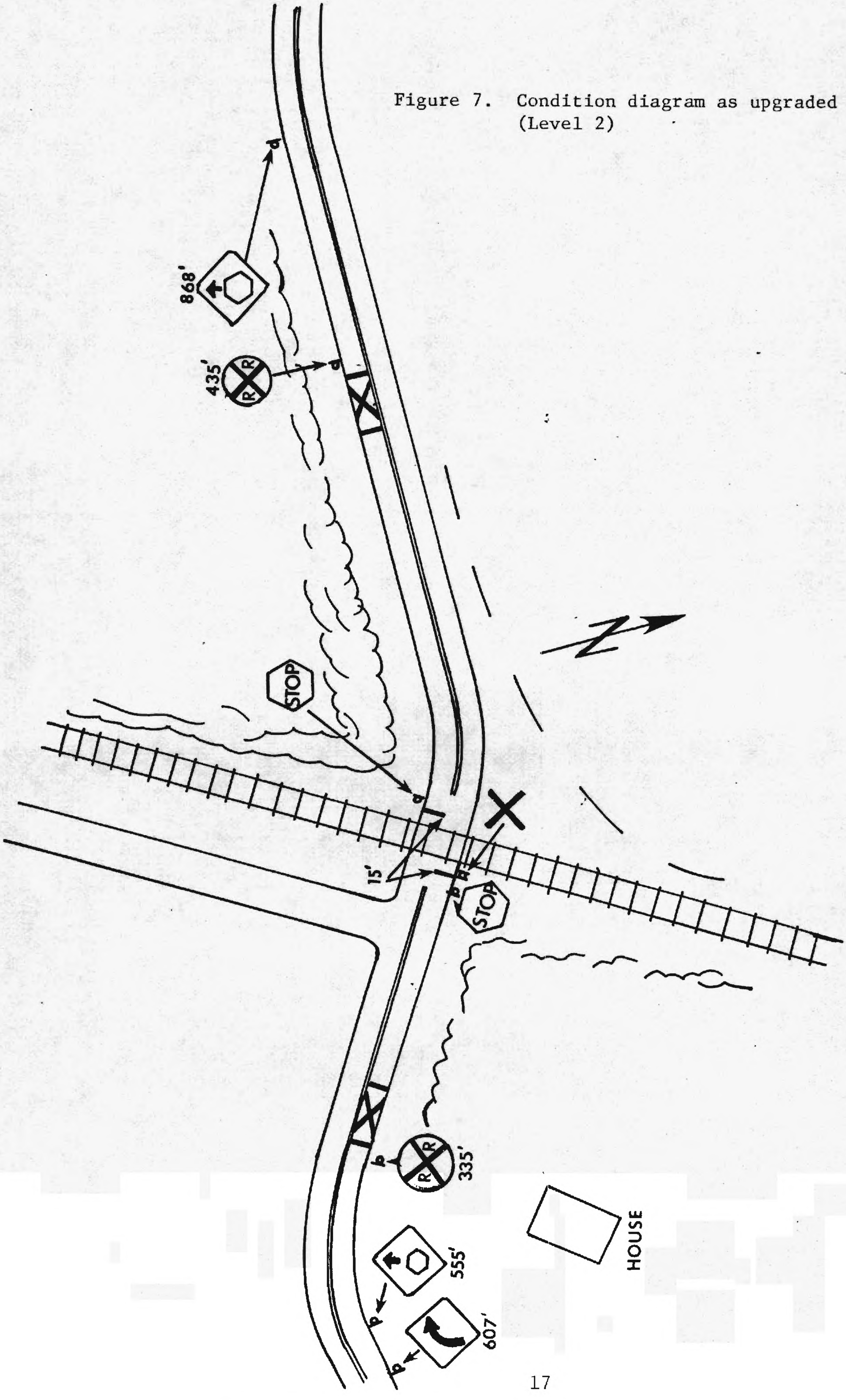
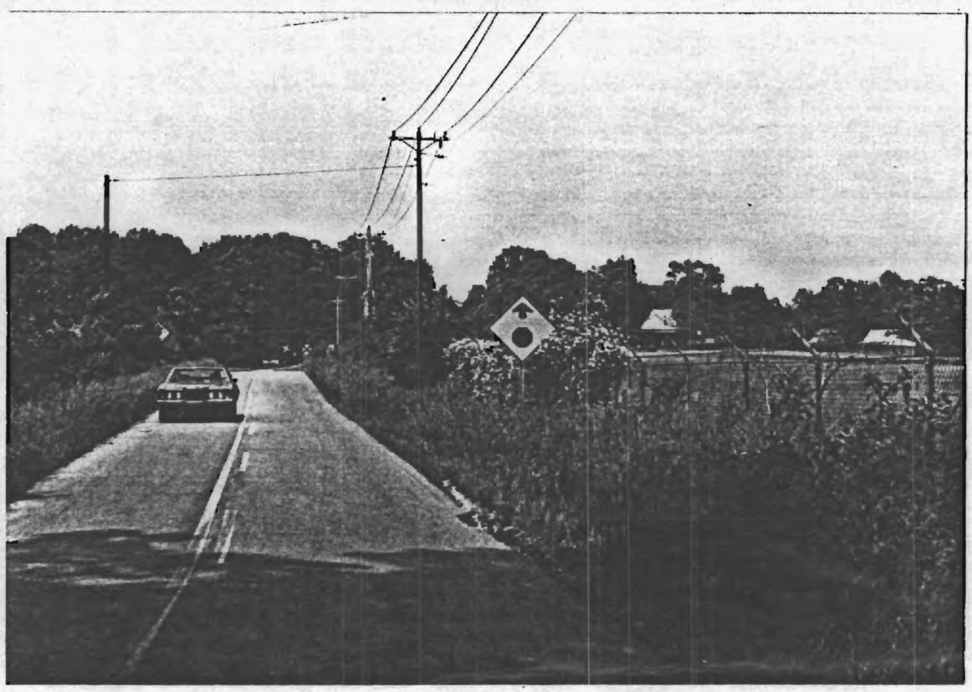


Figure 7. Condition diagram as upgraded to MUTCD (Level 2)

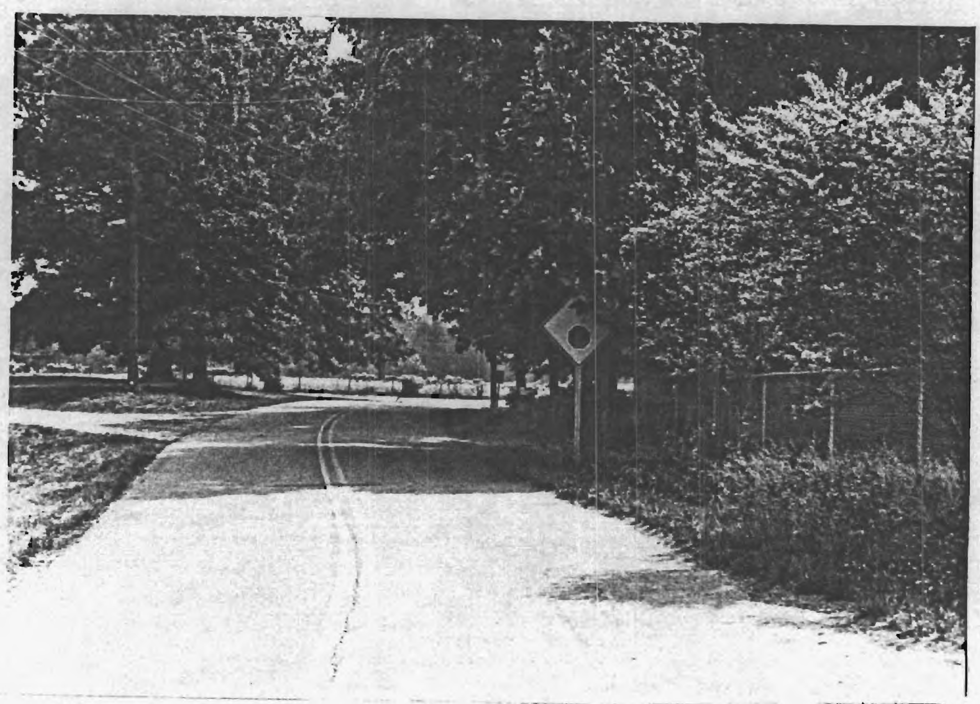
Figure 8. Photos of site in Level 2 condition (upgraded to MUTCD standards)

8 a. Crossbuck sign and markings 435 feet from crossing (eastbound traffic on west approach).



8 b. STOP AHEAD sign 870 feet from crossing (Eastbound traffic on west approach).

8 c. Crossbuck sign and markings 335 feet from crossing (westbound traffic on east approach)



8 d. STOP AHEAD sign 555 feet from crossing (westbound traffic on east approach)

For safety, a full stop is necessary.

Driving westbound on the east approach, the visibility of the crossing itself is confined to the last 400 feet because of the winding alignment. Vision along the tracks to the north is poor because of a forested front yard of a resident. Visibility to the south is better because of a grassed front yard, but is limited by a hillock. For safety, it is necessary to slow down almost to a stop.

During the initial drive-through it was noted that neither approach satisfies MUTCD standards.

Pilot observations, assisted by a radar speed meter, showed that a significant fraction of the motorists slowed down no more than necessary to negotiate the crossing, to a speed between 20 and 25 mph. They relied entirely on the locomotive engineer's duty to sound the horn for the crossing.

Collection of Performance Data (A-3)

This activity includes the development of a data-collection plan, followed by the collection and summarization of the data.

Data Collection Plan. The purpose in this step is to plan all aspects of data collection, as discussed more specifically under Activity F-1 of the Positive Guidance Users' Guide. The plan should specify the experimental design; the selection of measures of effectiveness (MOEs); the data-collection plan, including data needs, sample size and sampling; and the statistical analysis plan. The following paragraphs cover these four areas in order, and are supplemented by a number of appendix figures.

The experimental design was selected to be of the before-and-after type, inasmuch as no control site with similar characteristics is available. Reference 6 was very helpful in planning the details of the data collection plan and the statistical analysis.

Appendix Figure 1 shows that the objectives of this project are to improve driver performance in slowing down at a safe rate, stopping at a safe distance from the track, and looking both ways before crossing. These, then, are the MOEs of interested, as presented in Appendix Figures 2 and 3.

The third step is to prepare a detailed data-collection plan to spell out the specific data needs, sample size, data collection procedure and schedule. Figures 9 through 12 show the following field forms developed to measure the selected MOEs:

- Radar-obtained crossing speeds of all lead vehicles (Form A)
- Certain data on train arrivals (Form B)
- Location of stops (Form C)
- Driver looking behavior (Form D)

Initially, the crossing speeds of vehicles (Form A) were planned to be obtained just as the vehicle reached the tracks, partly to minimize the duration of the radar signal and thus avoid alerting drivers equipped with "Fuzzbusters". However, it was found that the best-performing drivers would come to a stop well back from the tracks and then accelerate briskly across. Their speed at the tracks might well exceed that of a poor driver who did not stop at all. Therefore the entry on the form is the minimum speed as the vehicle approaches and crosses the tracks.

The data on train arrivals (Form B) did not include train speed because enough such data were obtained in the pilot studies.

The locations of stops (Form C) were determined and recorded by hidden observers near the tracks and at least 500 feet away from the crossing. The three zones of stopping were identified on the assumption that at least 10 feet of clearance from the nearer rail to the front bumper of the vehicle are required for safety.

Figure 9

Positive Guidance Demonstration Project
Railroad-Highway At-Grade Crossing in Kennesaw, Georgia

FIELD FORM A: RADAR-OBTAINED CROSSING SPEEDS OF ALL LEAD VEHICLES

Approach E W bound; Date ______________; Weather ____________; Observer ____________
Level of Improvement: Upgraded to MUTCD

Time of Day	Arrived After Whistle?	Speed	Time of Day	Arrived After Whistle?	Speed	Time of Day	Arrived After Whistle?	Speed

Note: This form is used for all lead vehicles crossing during daylight hours, whether or not a train is coming. A lead vehicle is one not influenced by a veh. in front of it. The middle column shows whether a train was coming. The Speed entry is the minimum speed shown by a digital radar speed meter as vehicle approaches and crosses the tracks. For example, if the vehicle slows down to 3 mph and accelerates across the tracks such that his speed is 7 mph at the tracks, you would enter the minimum speed, which was 3. This criterion began Jan. 12, 1979.

Figure 10.

Positive Guidance Demonstration Project
Railroad-Highway At-Grade Crossing in Kennesaw, Georgia

FIELD FORM B: CERTAIN DATA ON TRAIN ARRIVALS

Approach E W bound; Date ________; Weather __________; Observer __________

Level of Improvement: Upgraded to MUTCD

TOD of Whistle	Train Direction N,S bound	Seconds from Whistle to Arrival

Note: Train speeds were obtained in a separate study

Figure 11.

Positive Guidance Demonstration Project
Railroad-Highway At-Grade Crossing in Kennesaw, Georgia

FIELD FORM C: LOCATION OF STOPS

Approach E W bound; Date____________; Weather______________; Observer_______________

Level of Improvement: Upgraded to MUTCD

	Location of Stops*				Location of Stops*		
TOD	0'-10'	10'-20'	Over 20'	TOD	0'-10'	10'-20'	Over 20'

Note: A vehicle "stops" if it slows to a full stop or almost to a stop. "Almost" means no more than about 1 mph. The wheels need not stop completely to turn. If it is difficult to determine a location zone of stopping, then that means that the vehicle did not stop, and no entry is made.

Figure 12. PSP/4/80

Positive Guidance Demonstration Project
Railroad-Highway At-Grade Crossing in Kennesaw, Georgia

FIELD FORM D: DRIVER LOOKING BEHAVIOR

Approach E W bound; Date______________; Weather_____________; Observer________________

Level of Improvement: Upgraded to MUTCD

TOD	Lead Veh?	Did Not Look	Looked Left	Looked Right	TOD	Lead Veh?	Did Not Look	Looked Left	Looked Right
___	___	___	___	___	___	___	___	___	___
___	___	___	___	___	___	___	___	___	___
___	___	___	___	___	___	___	___	___	___
___	___	___	___	___	___	___	___	___	___
___	___	___	___	___	___	___	___	___	___
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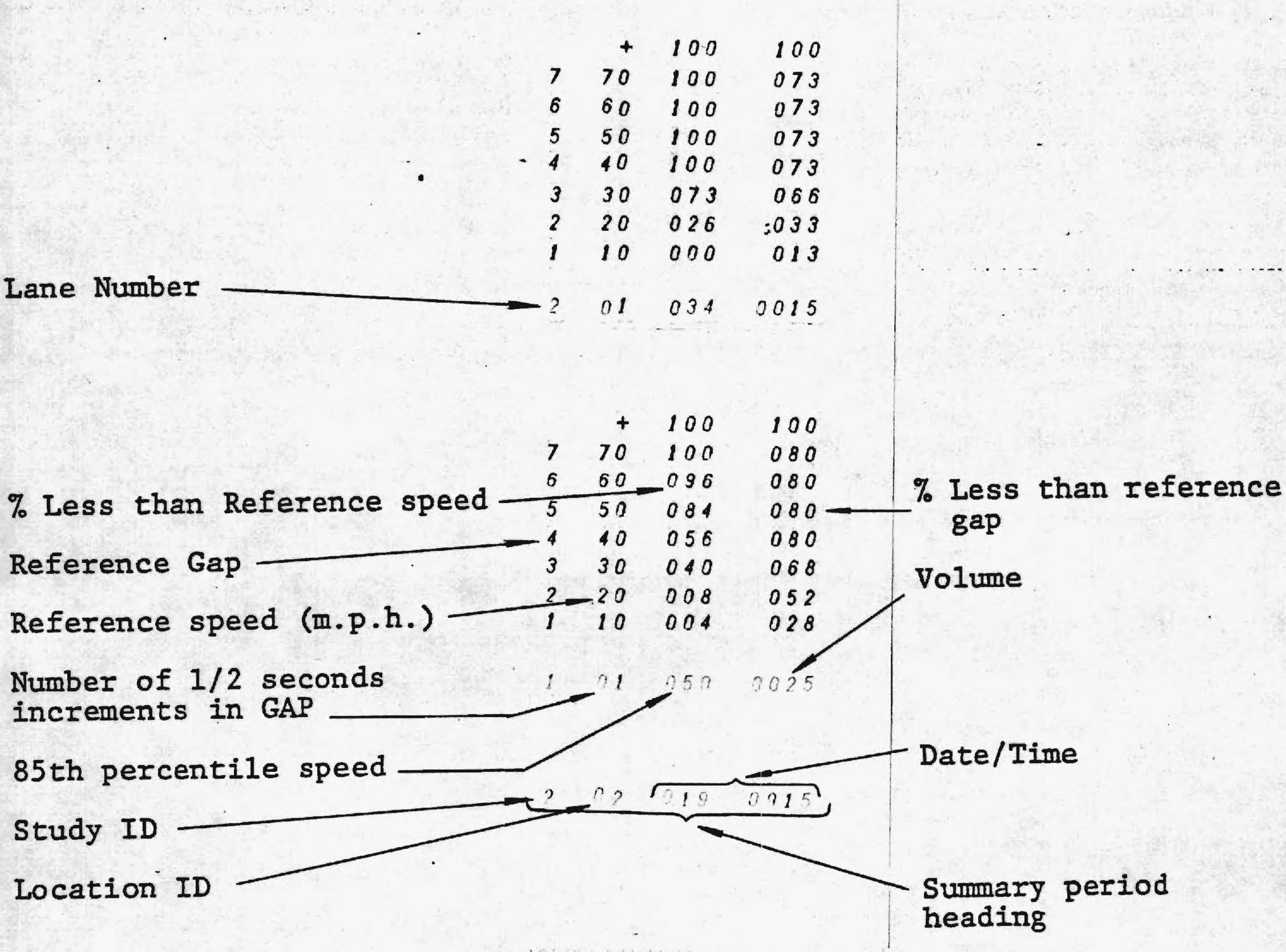
The driver looking behavior (Form D) was also determined and recorded by hidden observers.

In addition it was desired to obtain speed profiles for the final 500 feet of each approach. It was planned initially to use time-lapse photography for this purpose, but to conserve film and office-analysis time by "shooting" only those vehicles that arrived when a train was approaching. However, it was found that an entire day of waiting might yield only one or two vehicles that coincided with a train. Moreover, the silver market drove the price of film to more than double the budgeted cost. Therefore this method was abandoned after filming a few vehicles on the west approach during the Level 1 work.

Speed profiles were also planned to be obtained by means of pairs of tapeswitches located 10, 50, 100, 200, 300 and 500 feet from the crossing. Georgia Tech uses a RATEM II microprocessor, designed by Professor Ken G. Courage of the University of Florida, to record the tapeswitch closures and print out statistical summaries on paper tape in the field. Figure 13 is a generalized example of the output from the microprocessor when it is used for tapeswitch studies. The figure illustrates two lanes of a freeway; up to eight lanes could be monitored simultaneously within the capacity of the microprocessor. On the present project six locations on a single lane were monitored. Figures 3 and 4 show the tapeswitches in place on each approach, with the wires leading off to a small tent, out of sight of the motorists, where the microprocessor and printer were located.

Figure 14 and 15 show the tapeswitches and microprocessor, respectively. The drive-through movie for the Level 2 condition also shows the tapeswitches, and indicates that they are all but invisible to the motorist at speed. They are less than 3/16 inch thick, including the layers of tape, and are quite silent and unobtrusive. Figure 14 makes it clear that they are quite visible to a slow driver close to the track. Ignored by motorists during level 1 and 2 evaluations, the tapeswitches became a target for vandals after the Positive Guidance solution was installed.

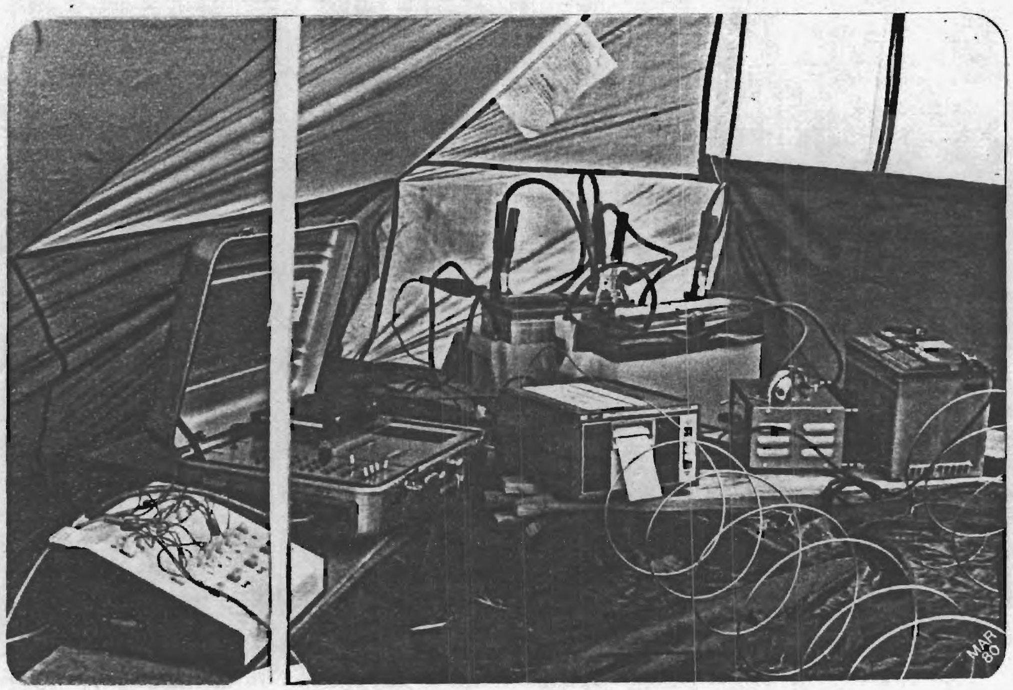
Figure 13. Sample output from microprocessor used for tapeswitch studies



SUMMARY HEADING (RED)

Figure 14. Tapeswitches in place on Stanley Road

Figure 15. Microprocessor and printer in tent



All field observations were performed continuously from 7:00 a.m. to 6:00 p.m. on two normal weekdays and a Saturday and a Sunday. Refer to Appendix Figure 9. The hours were intended to represent daylight hours for the average season of the year. (Daylight hours are necessary for observing head movements). The microprocessor was programmed to print out only at the end of the day, as there was no intention to stratify results by time of day of vehicle arrival. Initially it was planned to turn off the tapeswitch inputs whenever a train approached, so that vehicles forced to come to a complete stop would not bias the summarized output. It was found, however, that such vehicles were an insignificant fraction of the total, so the microprocessor was left unattended during the day.

After the site was upgraded to meet the MUTCD an acclimation period of 30 days was allowed to pass before driver-performance data were taken again. See Appendix Figure 5.

The statistical analysis plan called initially for frequencies, means and dispersions about the means to be determined for the manually-collected data. Only the mean speeds at the six tapeswitch locations were planned to be used initially. Appendix Figure 7 shows the following plans for statistical comparisons between the various levels of improvement (6):

- Chi-square tests for looking behavior (head-turning)
- t tests or ANOVA for radar speed measurements of lowest speed on approach
- Chi-square test for zone of stopping
- Chi-square test for speed profiles obtained by tapeswitches

Later it was decided to calculate the eighty-fifth precentiles of speeds determined both by radar and by tapeswitches, in order to focus on the behavior of the reckless drivers in the streams.

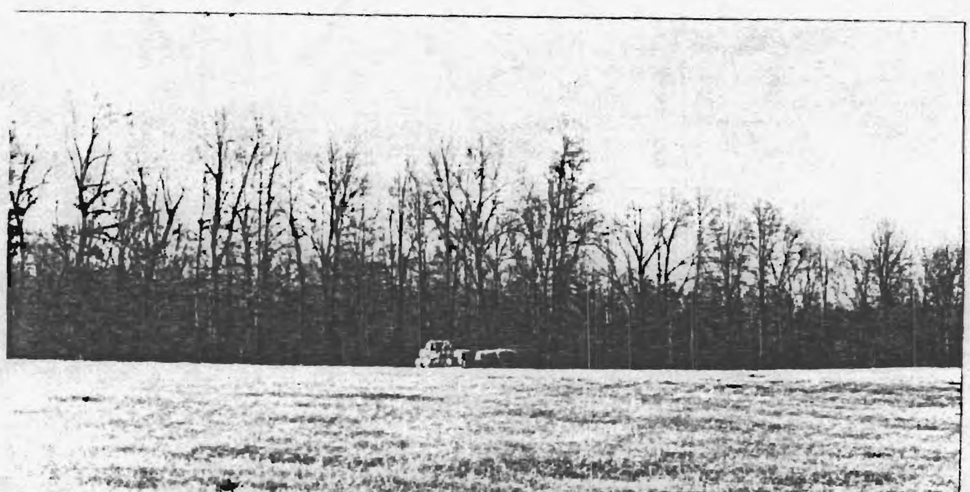
Collection and Summarization of Data. Manual data collection was performed each day by two shifts of observers--7:00 a.m. to noon and noon to 6:00 p.m. The work was uneventful once it was realized that local drivers are unexpectedly observant of changes they do not understand. For example, the markers placed on the fence for the time-lapse photography provoked a number of curious drivers to stop, despite the fact that from the road they were seen as beige, with no patterns. Also, it was learned that motorists must never see an observer wearing a camouflage poncho, as that marks him as a spy of some kind, particularly if he is carrying binoculars and a walkie-talkie as well. It was learned that observers must be absolutely and totally hidden at all times, at all angles of the sun, and in all seasons. In winter, when foliage is sparce, used Christmas trees can be set in place to form an effective blind. Hay bales can be used effectively for cover, provided the observers are at least 400 feet from the road (Figure 16). Eight-power, wide-angle binoculars may need to be supplemented by a 20-power telescope for any observations of head movements that must be taken from 1000 feet away.

It came as a surprise that the use of property for field observations is not always as easy as it seems on its face. Permission to use a pasture or farmland may be denied for some good reasons, and for some that are arbitrary and capricious but nonetheless binding.

The use of tapeswitches and microprocessor is satisfactory for researchers who are determined to get the data at whatever cost in time and effort; but it is not a method of data collection suitable for operating agencies at this time. The primary problem is that the microprocessor is not of CMOS design and therefore draws heavy current (4 amps). Large lead-acid, marine-type batteries are required to power the unit and the digital printer requires a large battery

Figure 16. Collection of data on looking behavior and (radar) speed

16 a. Observations of westbound traffic in early stage of project. Stanley Road lies beyond the bushes and home in background.



16 b. Station is inobtrusive from Stanley Road.

plus an inverter. What is needed is a system the size of a Streeter-Amet volume counter that can be chained to a pole and left unattended without fear of theft, vandalism, or overheating from the sun. Presently, the unattended operation in a tent is risky and it demands placement at inconvenient locations far from the road.

The data collection for Level 1 (the As-Is condition) was performed primarily during the winter months of January and February, 1980. Only 33 trains passed during the four days of observation of each approach (eight days in all), due to the fact that track repairs were being made (during working hours). The mean time from the sounding of the train's horn until it reached the crossing was 16.8 seconds, with a standard deviation of 6.04 seconds. A total of 1604 vehicles were observed during the level 1 period.

The data collection for level 2 (the MUTCD condition) was performed in April and May, 1980, 30 days after the site was upgraded. A total of 2271 vehicles were rated by the observers for minimum speed of crossing, stopping location and looking behavior. It was obvious to the project staff that driver performance under level 2 conditions was still inadequate. A Positive Guidance solution was clearly still needed to improve driver behavior. The following paragraphs present the data summaries and the primary results of the comparisons. The details of the statistical comparison of levels 1 and 2 are given in reference 5.

The approach-speed profiles, obtained from tapeswitch data, are presented in Table 1 for both level 1 and level 2 conditions. The table reports eighty-fifth percentile speeds, rather than means, in order to focus on the drivers most likely to become involved in an accident. Table 1 shows that eastbound drivers at the eighty-fifth percentile speed do not come into compliance with the 35 mph speed limit until they are less than

200 feet from the crossing. The speed limit on the other approach is self-enforcing because of the horizontal curvature. It is apparent from Table 1 that upgrading the location had no significant effect on approach speeds. The slight increase in speed at a distance of 100 feet from the track undoubtedly is due to the fact that the railroad rebuilt the crossing between the level 1 and level 2 studies. Although the smoothness of the crossing was not changed much, the fresh asphalt presents a better appearance.

The lowest speed on the approach to the track is probably the most important MOE in this study. These data were collected by means of a hand-held radar speed meter, by an observer who was totally concealed. The mean lowest speed of eastbound traffic increased from 5.50 to 7.34 mph under level 1 and level 2 conditions respectively. This was a highly significant change. On the westbound approach the mean of the lowest approach speeds decreased from 10.9 to 7.5 mph, a significant improvement. However, the eastbound approach is more in need of improvement because of the more severe sight restrictions.

Table 2 shows the data on stopping location and the percent of motorists stopping, for levels 1 and 2. The essential conclusion to be drawn from Table 2 is that the level 2 upgrading improved the stopping location, but the number of drivers not stopping increased significantly from level 1 to level 2.

Cross tabulations of various categories of looking behavior during levels 1 and 2 are shown in Tables 3 and 4 for eastbound and westbound drivers, respectively. The tables show that after upgrading to MUTCD standards, fewer drivers looked for trains. Analyses detailed in

Table 1. Speeds from tapeswitch data, Levels 1 and 2

EASTBOUND

Distance From Track, feet	Eighty-fifth percentile speeds — Level 1 Avg. of 4 days	Level 1 Std. Dev.	Level 2 Avg. of 4 days	Level 2 Std. Dev.
10	10.93	0.75	11.76	0.50
50	19.80	1.40	19.00	0.00
100	27.70	0.49	27.31	0.96
200	37.16	0.90	35.85	1.41
300	40.16	2.51	40	4.27[a]
500	43.51	0.98	42.84	1.26

WESTBOUND

Distance From Track, feet	Level 1 Avg. of 4 days	Level 1 Std. Dev.	Level 2 Avg. of 4 days	Level 2 Std. Dev.
10	13.49	1.00	13.75	0.96
50	19.45	0.58	18.25	0.96
100	26.51	0.58	26.99	0.82
200	33.82	0.96	32.78	0.96
300	35.00	0.00	34.73	0.50
450	37.72	0.96	36.73	0.50

[a] The microprocessor was set to cover a speed range of either 3 to 39 mph, or else 6 to 42 mph. Therefore eighty-fifth percentile speeds over 39 or 42 may not be precise and can have a large standard deviation for reasons unrelated to the actual traffic speed.

Table 2. Stopping zone and precent of motorists stopping, levels 1 and 2

EASTBOUND

Stopping distance from track, feet	Percent of Vehicles in Zone Level 1	Level 2
0 - 10	18.0	9.2
10 - 20	39.6	28.4
Over 20	3.7	5.6
No Stop	38.7	56.8
	100.0	100.0

WESTBOUND

Stopping distance from track, feet	Percent of Vehicles in Zone Level 1	Level 2
0 - 10	7.7	3.8
10 - 20	14.4	12.6
Over 20	6.8	6.5
No Stop	71.1	77.1
	100.0	100.0

Table 3. Looking behavior for eastbound drivers, levels 1 and 2

	Level 1		Level 2	
	Yes	No	Yes	No
Looked Left	85.9%	14.1%	82.6%	17.3%
Looked Right	85.9	14.1	81.1	18.9
Looked One/Both Directions	89.9	10.1	86.1	13.9

Table 4. Looking behavior for westbound drivers, levels 1 and 2

	Level 1		Level 2	
	Yes	No	Yes	No
Looked Left	88.1%	11.9%	76.2%	23.8%
Looked Right	86.7	13.3	75.2	24.8
Looked One/Both Directions	91.2	8.8	81.7	18.3

reference 5 show that these changes were highly significant (at the 99% level of confidence). The project staff is inclined to believe that in fact the changes are due to the unavoidable use of different observers for the two evaluations. Also, below-freezing temperatures may have affected the reliability of the judgement of the level 1 observers. In any case, it is apparent that level 2 looking behavior leaves ample room for improvement through a Positive Guidance solution.

The section later in this report entitled FUNCTION F -- EVALUATION presents additional comments on level 1 and 2 results.

Preparation of Site File (A-4)

The information generated in Function A has been organized into an accessible and usable form.

FUNCTION B--SPECIFICATION OF PROBLEMS

The purpose of Function B is to specify the problems occurring at the site. The one activity is to identify, describe and rank hazards.

Identification of Hazards

Hazard may be attributed to objects, conditions or situations.

Object Hazards (moving)

- Approximately 37 trains per 24-hour period
- Noncompliance with control devices
- Turning vehicles at Line Road to Deveraux School

Object Hazards (fixed): None

Condition Hazards

- Short sight distance along both approaches
- Narrowing of the road at the crossing

Situation Hazards: None

Description of Hazards

Object Hazard (moving). According to State and railroad records, under normal conditions of railroad operation there should be about 37 trains at the crossing in a 24-hour period.

Object Hazard (moving). There is a noncompliance with traffic control devices in the form of STOP signs at the crossing. Many motorists do not stop and some slow down only enough to negotiate the crossing comfortably.

Object Hazard (moving). Cars turn into and out of the road (Line Road), adjacent to the crossing, on their way to and from the Deveraux School for emotionally disturbed children.

Condition Hazard. Sight distance for the approaching motorist from either direction is restricted, severely so for east bound vehicles.

Condition Hazard. There is a slight narrowing of the road at the crossing itself, but no conflicts or erratic maneuvers have been observed.

Ranking of Hazards

Table 5 shows that the numerous trains and the motorist noncompliance are the highest-ranking hazards.

Table 5. Description and ranking of hazards

Class	Description	Indicator	Severity
Moving Object	About 37 trains per 24 hours at the crossing.	Records	High
Moving Object	Non-compliance with traffic control devices.	Observations	High
Moving Object	Traffic on road to Deveraux School which is adjacent to crossing.	Observations	Moderate
Condition	Short sight distance down tracks from both approaches to crossing.	Observations	High
Condition	Narrowing of road at the crossing.	Observations	Moderate

FUNCTION C--DEFINITION OF DRIVER PERFORMANCE FACTORS

The purpose of this function is to analyze driver tasks associated with the problems specified in Function B. The four activities of Function C include an analysis of speeds and paths (trace analysis) characterization of driver expectancies; an assessment of detection and recognition factors; and an analysis of information load.

<u>Analysis of Speeds and Paths (Trace Analysis)</u> (C - 1)

Inasmuch as lane changes are not a factor at this site, we are concerned only with the range of speeds used by the drivers as they traverse the site. Figure 17, from Reference 2, illustrates that concept. It is desired that approaching drivers slow down at a safe rate, and come to a smooth stop. Late braking and/or failure to stop are undesirable. it follows that improvements in control devices should result in earlier braking, smoother deceleration, and a lower (preferably zero) minimum speed in the vicinity of the crossing.

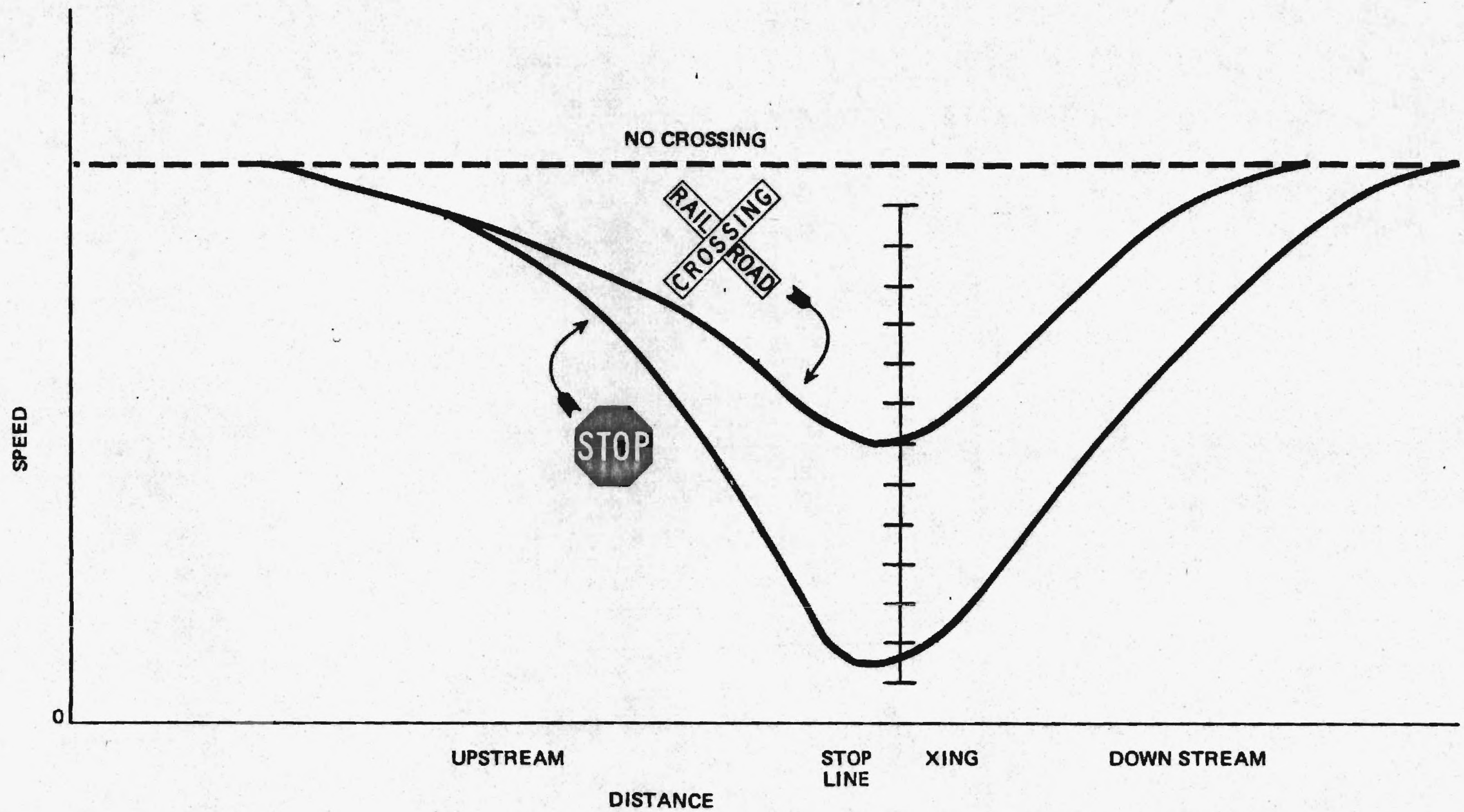
The collected data on speeds and stops were reported above under Function A.

<u>Characterization of Guidance and Navigational Expectancies</u> (C - 2)

This activity includes a review of the site for expectancy violations; an expectancy analysis; and a determination of expectancy violations.

<u>Review of Site for Expectancy Violations</u>. Southbound trains are difficult to see for both eastbound and westbound approaching motorists, until they reach the crossing. Northbound trains are difficult for eastbound motorists to see until they arrive at the STOP sign. This could cause a surprise situation for the motorist who expects to encounter "open" railroad crossings wherever he goes. Whether or not such motorists exist, the fact at this crossing is that virtually all drivers are local and are well aware

Figure 17. Concept of speed profiles for crossbuck and STOP sign grade crossings



Typical speed profiles for crossbuck and stop sign grade crossings. (Reference 2) of the crossing. Some of these drivers fully expect to be able to cross without encountering a train.

Expectancy Analysis. Table 6 presents the expectancy analysis in a formatted style.

Expectancy Violations. The factors of reduced sight distance and the presence of trains are presented as the source of expectancy violations in Table 7.

Assessment of Detection and Recognition Problems (C - 3)

This activity determines whether the hazards have the easy detectability and recognizability they require.

Detectability. Table 8 is a checklist for hazard detectability. It shows that the hazard is not in the driver's primary field of view, and that it is obstructed by terrain features and fences.

Recognizability. On a scale from "easy" to "difficult", trains are probably intermediate in their recognizability. Even with as many as 37 trains per day, the arrival of a train is still viewed as a relatively infrequent occurrence by the individual driver.

Detection and Recognition Problems. Table 9 is a description of detection and recognition problems in the form of an exhibit.

Analysis of Information Load (C - 4)

Information load involves the physical characteristics of the site and how evenly they are distributed along the driver's path. Figures 6 and 7 are condition diagrams that show the information load. At this site the loading is light, with no potential overloading of the driver.

Table 6. Expectancy analysis table

Location Description	Driver Responses	Expectancy and Status
Short sight distances on both approaches	Reduce speed and look	Expect to be able to see an oncoming train
Well traveled route by local motorists	Exhibit caution and look	Not expecting to find a train at the crossing as it is a relatively rare event

Table 7. Expectancy violation characterizations

Source	Characterization	Speed	Path	Direction	Information Needs
1. Reduced sight distance.	Reduced sight distance down both tracks (north and south) when eastbound. Reduced sight distance for trains approaching from the north when motorist is westbound.	x	-	-	Notification of reduced sight distance or blind crossing.
2. Trains at crossing.	Well traveled route by local motorists and with little expectancy for encountering a train at the crossing.	x	-	-	Alert driver to railroad crossing and traffic devices.

Table 8. Checklist for hazard detectability

Physical Traits	Yes	No
Does the hazard blend in with the background offering poor contrast?		x
Does the hazard offer a relatively small target for the conditions (e.g.,speed)?		x
Is the hazard in the driver's primary field of view?		x

Interference Factors	Yes	No
Do off-line terrain features obscure view of the hazard during approach?	x	
Does roadway alignment (vertical or horizontal) obscure view during approach?		x
Is sight distance blocked by manmade features?	x	
Do accident data indicate weather conditions as a factor in detectability?		x
Is adjacent traffic likely to interfere with detectability?		x
Does time of occurrence (season, time of day) influence detectability of hazard?	x	

Table 9. Descriptions of detection and recognition problems

Hazards	Detection or Recognition Problems	Compensating Information
Trains	Detection - Sight distance is reduced from both approaches.	Caution driver regarding limited view of tracks. Alert driver to railroad crossing and traffic devices.
	Recognition - Infrequency of trains at crossing.	

FUNCTION D--DEFINITION OF INFORMATION REQUIREMENTS

The objectives of this function are to identify the information needed by the driver to negotiate the problem location safely and efficiently and to determine the extent to which these needs are being satisfied by the current information system.

In this activity the problem location is divided into zones corresponding to the nature of the tasks the driver must perform approaching, through, and leaving the site.

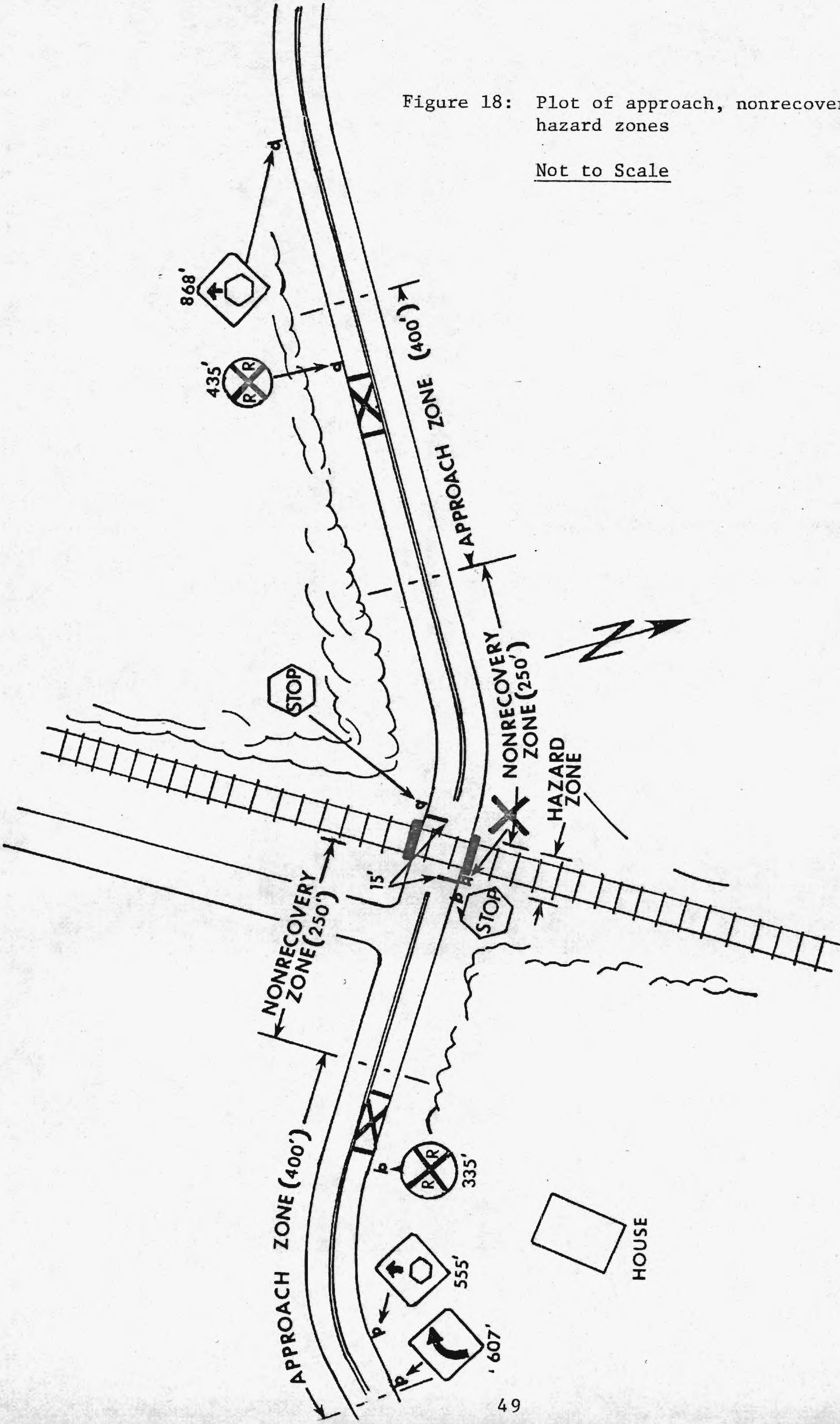
Approach, Nonrecovery and Hazard Zones. The plot of Figure 18 shows an Approach Zone, corresponding to the decision sight distance minus the desirable stopping sight distance. The Nonrecovery Zone begins at the point beyond which there is insufficient stopping sight distance. It was prepared for a design speed of 35 mph.

Need for Information. On the west approach, eastbound drivers can see the wood crossbuck and the STOP sign when they are 700 feet from the track, and their view is continuous up to the crossing. Therefore in the Level 1 condition there was no STOP AHEAD sign in place. On the east approach, westbound drivers cannot see the crossbuck and the STOP sign until they are approximately 200 feet from the crossing. That approach has had STOP AHEAD sign positioned approximately 555 feet from the track.

Since the upgrading to the MUTCD, the Level 2 condition, eastbound drivers now encounter a STOP AHEAD sign 870 feet from the track, plus a crossbuck sign and pavement marking 435 feet from the crossing. On the other approach, westbound drivers now find a crossbuck sign and marking 335 feet from the track. Also, their STOP AHEAD sign has been upgraded to the early version of the

Figure 18: Plot of approach, nonrecovery and hazard zones

Not to Scale



symbolic sign. (The larger octagon and arrow, adopted later, were not used).

Needs of the Advance and Downstream Zones. There are no needs for alerting information either upstream of the Approach Zone or downstream of the Hazard Zone.

Information Needs

This activity combines or assembles the statements from C - 2, C - 3, C - 4, and D - 1 into a single listing for the problem location.

These statements indicate clearly that the motorists already have warning of the STOP condition at the crossing. The problem is that the warning is not strong enough to grab their attention and induce adequate compliance. What is lacking in the warning system is redundancy. In the context of an at-grade highway-rail crossing, that redundancy may take two forms; i.e., repetition of the message by means of several signs, signals, or markings, and the use of multi-channel stimulation (e.g., rumble strips in addition to signs) (3).

Furthermore, eastbound motorists need more information related to the fact that there is a curve immediately before the track. That is, although the crossbuck and STOP sign are readily visible in advance, the crossing itself is not. See Figure 2g. In a sense it is a blind crossing, because the track itself is barely visible from a distance of 150 feet. The motorist can see the control devices required by the hazard, but the crossing itself is barely noticeable.

Table 10 is a formatted presentation of information needs and zone assignments. It shows the warning signs and markings in place during Level 2, after upgrading to meet MUTCD standards, and identifies the information still needed as a Positive Guidance solution. The table shows that some of the needed information should be located 100 feet in advance of an existing sign or marking. This selection of location anticipates the recommendation of

Table 10. Information needs and zone assignments

Location (Problem)	Location Description	Driver Performance	Problem Requiring Aiding	Information Need	Location (Need)
<u>West Approach</u> (Eastbound traffic)					
970 feet from crossing	STOP AHEAD Sign 870 feet from crossing	Notice sign, begin decel.	Noncompliance with STOP sign at crossing	Reinforcement of message to stop ahead	100 feet before STOP AHEAD sign
535 feet from crossing	Crossbuck sign and marking 435 feet from crossing	Notice sign and markings, decelerate smoothly	"	Indicate blind crossing ahead	100 feet before sign and marking
250 feet from crossing	Beginning of Nonrecovery zone	Brake smoothly to stop 15 feet from track	"	Reinforcement of STOP sign at crossing	250 feet from crossing
<u>East Approach</u> (Westbound traffic)					
650 feet from crossing	STOP AHEAD sign 555 feet from crossing	Notice sign, begin deceleration	Noncompliance with STOP sign at crossing	Reinforcement of message to stop ahead	100 feet before STOP AHEAD sign
435 feet from crossing	Crossbuck sign and marking 335 feet from crossing	Notice sign and markings, decelerate smoothly	"	Reinforcement of message that a crossing is ahead	100 feet before sign and marking
250 feet from crossing	Beginning of Nonrecovery zone	Brake smoothly to stop 15 feet before track	"	Reinforcement of STOP sign at crossing	250 feet from crossing

rumble strips in Function E. The placement of rumble strips 100 feet in advance of a sign or marking is intended to be the optimal location to apply the stimulus.

<u>Primacies of Information Needs</u> (D - 3)

The assignment of primacies is important in cases where multiple information needs exist in the same zone. In the case at hand, the factors of level of driver performance, severity considerations, and frequency considerations are not important. It is not necessary in this uncomplicated project to differentiate between the primacies of the information needs.

<u>Assessment of Current Information System</u> (D - 4)

Table 11 identifies the short comings of the current system by comparing it against the needs described above. The table shows a number of deficiencies in the existing, Level 2, information system.

Table 11. ASSESSMENT OF CURRENT INFORMATION SYSTEM

ZONES & INFORMATION NEEDS	PRIMACY	CURRENT CARRIER (PRESENCE)	COMPLETE	ACCURATE	CLEAR	USABLE	PROPER LOCATION	AMOUNT	ADEQUATE SIGHT DISTANCE
EASTBOUND APPROACH ZONE									
Warn of stop ahead	High	2c-15	1	OK	2	OK	OK	OK	OK
Warn of blind railroad crossing	High	W10-1 and pavement crossbuck	1, 4	OK	OK	OK	OK	OK	OK
Final warning of stop and crossing at end of Approach Zone	High	None							
WESTBOUND APPROACH ZONE									
Warn of stop ahead	High	2c-15	1	OK	3	OK	OK	OK	OK
Warn of railroad crossing	High	W10-1 and pavement crossbuck	1	OK	OK	OK	OK	OK	OK
Final warning of stop and crossing at end of Approach Zone	High	None							

1. Needs to be reinforced by redundancy or rumble strips
2. Should be upgraded to larger octagon and larger arrow
3. Overhanging foliage needs to be cut back
4. Lacks indication that crossing is blind

FUNCTION E--DETERMINATION OF POSITIVE GUIDANCE INFORMATION

The purpose of this function is to bring together the conclusions reached in the previous activities in order to identify a Positive Guidance solution to the problem.

Identification of Control Devices Applicable to Information Needs (E - 1)

The first step in this activity is to discuss the types of control devices that might meet the needs identified above. Reference 3 offers a number of recommendations for consideration in the design of more-adequate grade-crossing warning systems. There is always the temptation to grab the motorist's attention by means of a unique sign. If used at non-unique locations, such signs tend to be self-defeating over the long run. If successful at the first location, they will proliferate until they are no longer unique and have lost their original effectiveness. A sign showing a pink locomotive on a blue background would get everyone's attention at the first installation, at least for a time, but would not create much of a stir in widespread use.

A recent study (4) found that no sign, or group of signs, was consistently more effective than another in decreasing the potential hazard at horizontal curves in rural two-lane situations. It was concluded that "the proliferation of curve-warning signs may have lessened the average motorist's respect for the message they convey." These results argue against the use of either redundant or unique signs in this project. The location has severe sight-distance problems, to be sure, but a case for uniqueness can hardly be made when virtually all of the motorists on Stanley Road are thoroughly familiar with the crossing.

Reference 3 sets forth the principle of multi-channel stimulation (e.g., rumble strips) in addition to signs. The rumble strips offer a cross-modality stimulation that is both tactile and auditory. They offer an attractive reinforcement to the visual stimulation of the signs (provided they are not installed "everywhere").

Rumble strips are formed of corrugations of 3/4 inch depth. They should not be used indiscriminately in residential areas, such as our east (westbound) approach, as their noise can constitute an annoyance or nuisance to the neighbors. (Atlanta's Fulton County, for example will not install rumble strips in a developed area unless all residents within 300 feet certify that they will not complain). Furthermore, a local driver who uses the route frequently may avoid the noise and vibration by crossing the centerline into the lane used by oncoming traffic. Such a maneuver could pose a greater hazard than the trains.

Design of Positive Guidance Plan (E-2)

This activity selects the components that will make up the Positive Guidance solution for the problem site. Then a plan is designed for the entire information system at the site.

Selection of Applicable Control Devices. Standard GDOT design procedure is to use rumble strips in sets of three. Therefore it was decided to install three strips on each approach to the crossing. They would be located to call attention to the selected warning signs, described next. The eastbound approach offers a poor view of the tracks from a distance. It was decided to install a LOOK FOR TRAIN sign 150 feet from the crossing. A rumble strip 250 feet from the crossing hopefully would alert motorists into noticing this sign. The 250-foot placement also coincides with the beginning of the nonrecovery zone (Fig. 18). Also, a HIDDEN XING sign was selected for placement below the RR crossbuck sign 435 feet from the crossing. The word HIDDEN was specifically considered preferable to BLIND. A second rumble strip was designed to be placed 100 feet upstream of that sign. The third rumble strip was designed to be deployed 100 feet in advance of the symbol STOP AHEAD sign.

The Positive Guidance solution for the westbound approach did not feature any new signs or markings. Rumble strips were selected for placement at 250, 435 and 655 feet from the crossing. The latter two call attention to the RR crossbuck and STOP AHEAD signs, respectively.

The school-access road parallel to the railroad track was given special attention in the Positive Guidance solution. Drivers leaving the school, approaching Stanley Road, and then turning left and crossing the tracks would not be exposed to any of the advance-warning signs or the rumble strips. Therefore a novel diagrammatic sign was proposed for these drivers. It is shown in the figure introduced next.

Preparation of Plans and Specifications. Figure 19 is a diagram of the proposed Positive Guidance solution, called the level 3 condition. It is the level 2 diagram shown in Figure 7, with the addition of the rumble strips on both approaches, the LOOK FOR TRAIN and HIDDEN XING signs on the eastbound approach, and the diagrammatic left-turn railroad crossing sign on the access road paralleling the railroad track.

Figure 20 is a set of photos showing all of the Positive Guidance signs and two of the rumble strips. The photos also reveal that Stanley Road was resurfaced and restriped by the County prior to the Positive Guidance installation. The photos of Figure 8, earlier in this report, showed that, prior to the repaving both approaches were quite smooth and merely had some transverse and longitudinal cracking. The project staff is of the opinion that the resurfacing would not significantly increase speeds on these approaches.

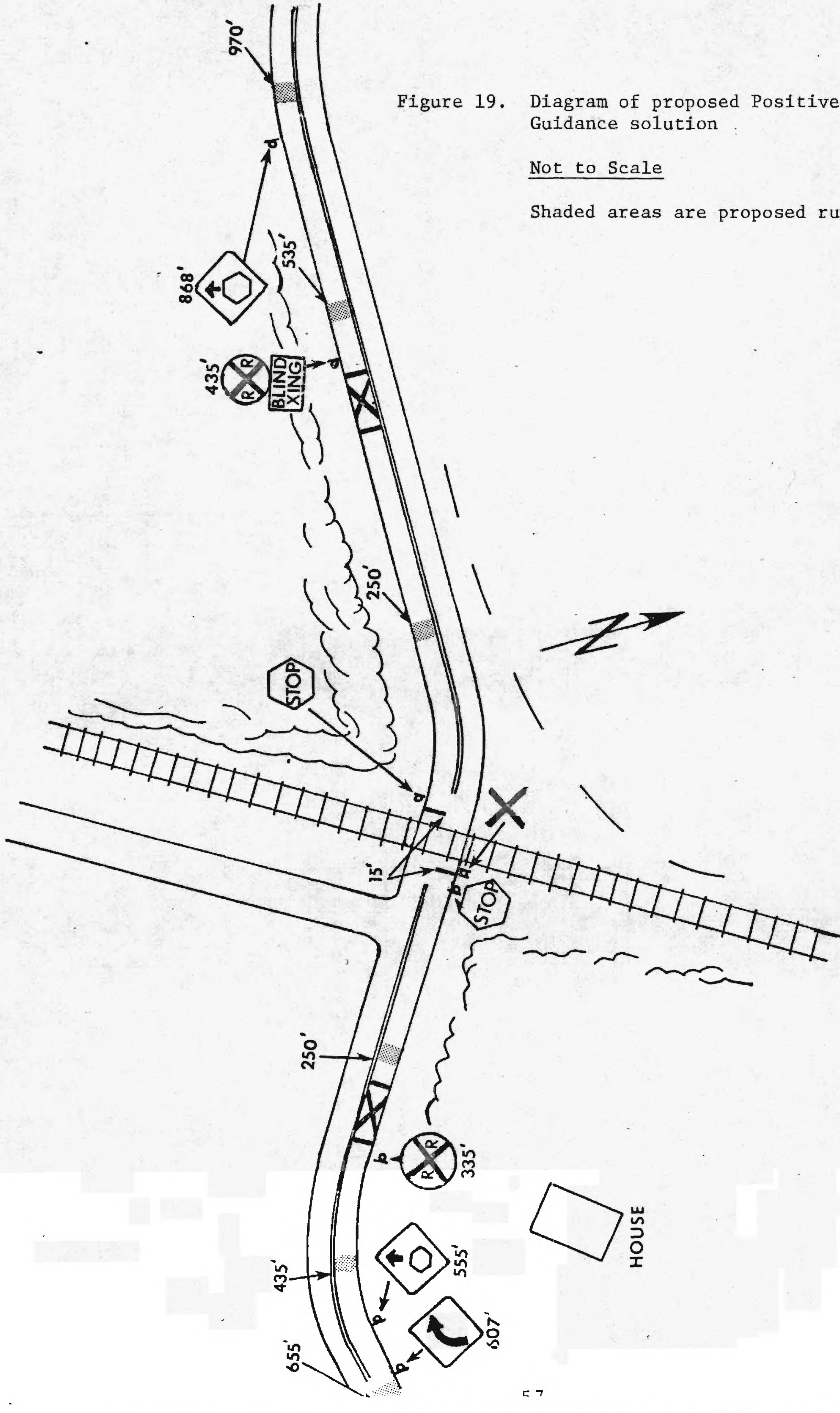
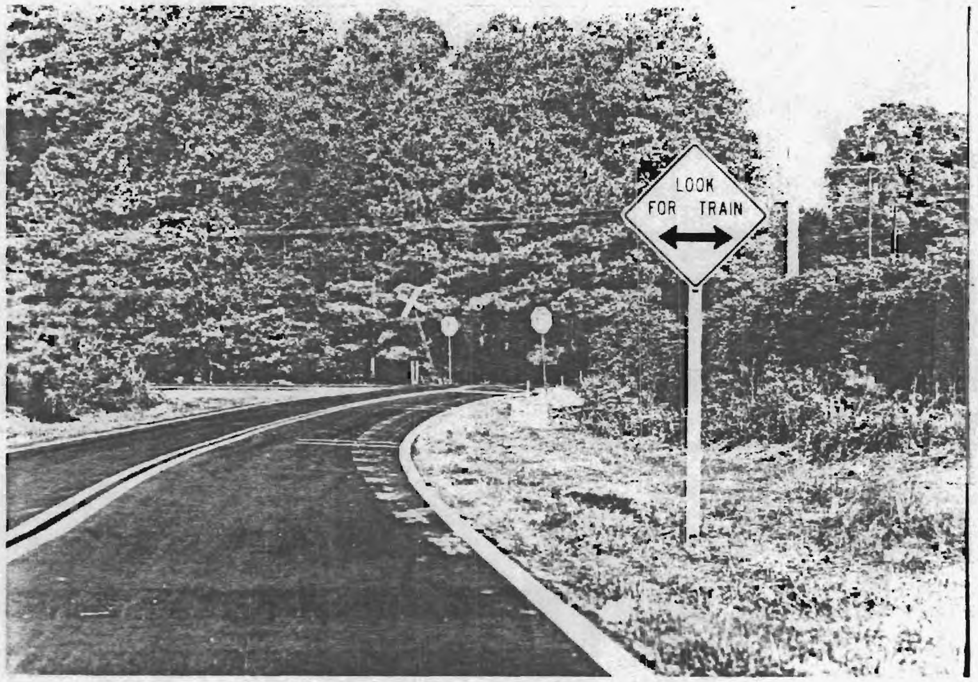


Figure 19. Diagram of proposed Positive Guidance solution

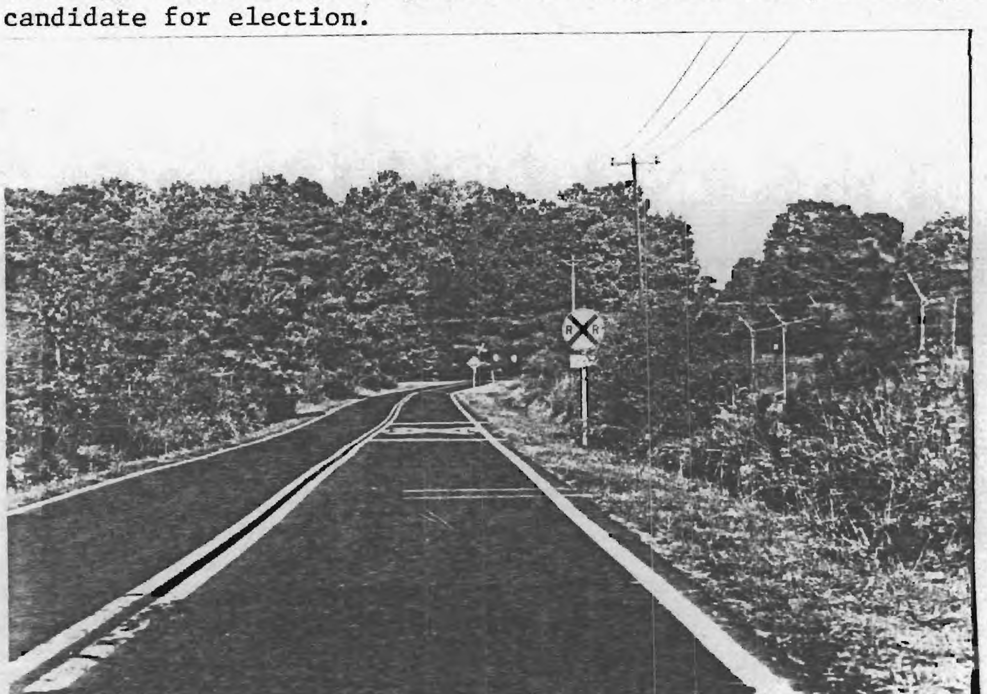
Not to Scale

Shaded areas are proposed rumble strips

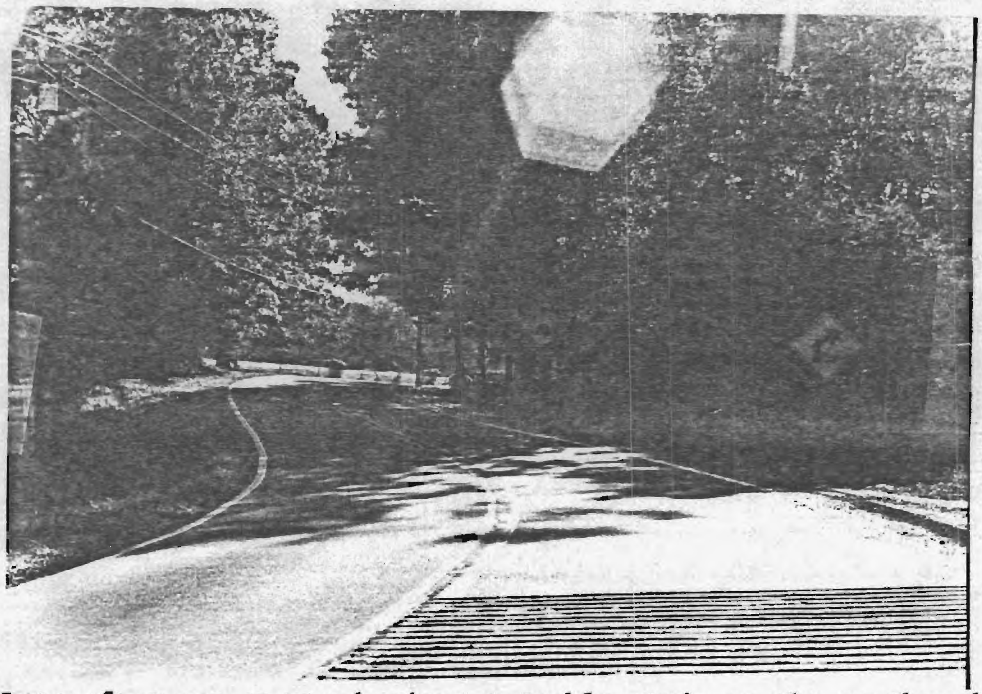
Figure 20. Photos of site in level 3 condition (Positive Guidance)



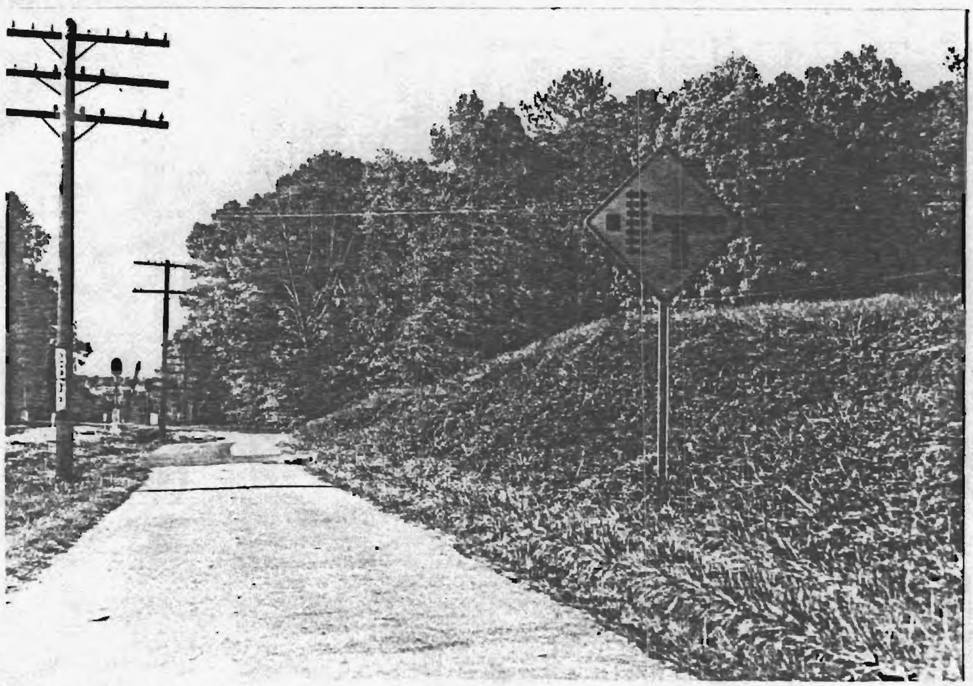
20a. LOOK FOR TRAIN sign 150 feet from crossing (eastbound traffic on west approach). Sign on ground in background was placed by a candidate for election.



20b. HIDDEN XING sign below RR crossbuck sign, eastbound direction, 435 feet from crossing, partially obscured by bush. Note rumble strip in foreground, pair of tapeswitches beyond.



20c. Late afternoon sun emphasizes a rumble strip on the westbound approach, 655 feet from crossing.



20d. Diagrammetic left-turn railroad crossing sign on the access road next to the track.

FUNCTION F --EVALUATION

Evaluation is necessary to (1) determine how effective the Positive Guidance solution has been in eliminating or minimizing the problem; (2) indicate if and where further modifications to the plan are warranted; and (3) provide information to other jurisdictions so that they can benefit from the results.

The three principal activities in the evaluation function are to develop an evaluation plan, conduct the evaluation, and analyze and interpret the data.

<u>Development of an Evaluation Plan</u> (F-1)

This activity selects the appropriate experimental design, the variables of interest, the data collection plan, and the types of statistical analysis. All of these had to be determined early in the project in order to perform the data collection land analyses for levels 1 and 2. See Function A-3, collection of Performance Data, earlier in this report for a thorough discussion of this activity.

The data collection to evaluate level 3, the Positive Guidance solution, was identical to that of levels 1 and 2 except that certain observers had to be moved to new locations. We were not permitted to deploy observers in the pasture in the northwest quadrant because they would have damaged a growing hay crop. Therefore the looking behavior of westbound motorists had to be observed by personnel deployed close to the railroad track and at a distance to the north and to the south of the crossing. Also, we were denied access to the pasture in the southwest quadrant. We simply had worn out our welcome with the farmer in the course of evaluating levels 1 and 2. Therefore the tapeswitches on the eastbound approach had to be connected to the microprocessor located on the east side of the tracks, in the woods in the northeast quadrant. The wires had to be run under the tracks, through a culvert pipe under Stanley Road, thence for several hundred feet to a hidden location in the woods.

For level 3, the observers were instructed to keep a record of the motorists who avoided the rumble strips by crossing the centerline into the oncoming lane. It was easy for the observers simply to listen for the sound of the crossing of each rumble strip.

Implementation of the Evaluation (F-2)

The level 3 signs were installed in mid-August, 1980, and the rumble strips were put in during the week of September 10. The evaluation data were collected from mid-October to early November, 1980.

Unlike the experience of levels 1 and 2, it was found in the level 3 evaluation that the tapeswitches and their wires were a target for vandals. Figure 20 shows that the tapeswitches are especially visible in an afternoon sun. Almost every day a tapeswitch was taken up, or wires disconnected or removed. The data were gathered as quickly as possible, to minimize exposure. During the last two days a guard was posted all day to see that the installation was not vandalized. The main concern was that vandals might follow the wires into the woods to the tent sheltering the microprocessor and peripheral equipment.

It is entirely speculation as to the identity of the vandals. The project staff believes that they probably were not from the nearby boarding school for emotionally disturbed children. Probably a local motorist, possibly a nearby neighbor, made many crossings of the track each day and resented being subjected so frequently to the noise and vibration of the rumble strips. This area of Georgia is particularly conservative politically and especially resentful of governmental intrusion into their lives.

Analysis and Interpretation of Data (F-3)

This section presents the evaluation data obtained for level 3 operation (after the installation of the Positive Guidance solution) and compares these results with those obtained for levels 1 and 2. The data are for head-turning (looking behavior); percent of motorists stopping and their stopping location; approach-speed profiles determined by six pairs of tapeswitches on each approach; and the lowest speed of approach, as determined by a hand-held radar speed meter. Finally, data on train frequency and direction are presented for the three levels.

Head-Turning (Looking Behavior). In order to determine significant changes from level 1 to 2 to 3, this MOE was divided into six categories, as follows:

Eastbound traffic that looked Left
Eastbound traffic that looked Right
Eastbound traffic that looked One or Both Directions
Westbound traffic that looked Left
Westbound traffic that looked Right
Westbound traffic that looked One or Both Directions

Cross tabulations, by level of improvement, are shown in Table 12. A Chi-square test reported in Table 13 corrects for different sample sizes among the three levels.

For eastbound motorists, the tables showed that all looking tended to decrease slightly during the course of the study. While the fall-off is significant statistically, the degradation is not of much practical

Table 12. Looking Behavior for Levels 1,2 and 3

	Percent of Drivers					
	Level 1		Level 2		Level 3	
EASTBOUND	Yes	No	Yes	No	Yes	No
Looked Left	85.9	14.1	82.7	17.3	82.1	17.9
Looked Right	85.9	14.1	81.1	18.9	77.9	22.1
Looked One/Both Directions	89.9	10.1	86.2	13.8	85.9	14.1
WESTBOUND						
Looked Left	88.1	11.9	76.2	23.8	68.5	31.5
Looked Right	86.7	13.3	75.2	24.8	63.8	36.2
Looked One/Both Directions	91.2	8.8	81.7	18.3	75.2	24.8

Table 13. Chi-square results for looking behavior

Category	Chi-Square	Significant at 90% C.L.? [a]	Probability of Error Less Than
EASTBOUND			
Looked Left	5.88	Yes	0.053
Looked Right	19.98	Yes	0.000
Looked One/Both Directions	8.48	Yes	0.014
WESTBOUND			
Looked Left	70.3	Yes	0.000
Looked Right	87.6	Yes	0.000
Looked One/Both Directions	56.8	Yes	0.000

[a] Confidence Level

importance. For all levels of operation the looking behavior of eastbound motorists was observed from an ideal, straight-ahead location.

For westbound motorists, there is a more pronounced decrease in all types of looking. It is conceivable that the differences from one level to another are due to the fact that the observers were not the same individuals. Also, they had to observe from locations that varied from level to level because of the changing availability of vantage points. In the level 1 evaluation, westbound motorists were observed from a straight-ahead position through a 20-power telescope. In level 3, they were observed from the side, from a much closer location, using eight-power binoculars. Both locations should produce excellent results on looking to the left, and that type showed a decrease from 88 to 68 percent of the drivers.

Conclusion: Looking behavior became progressively worse from levels 1 to 2 to 3.

Stopping Location and Percent Stopping. A Chi-square analysis was used to determine significant changes in the stopping location of drivers for the three levels of improvement. A four-by-three contingency table, including non-stopping drivers, is presented in Table 14, and the percentage of motorists stopping is shown in Table 15. Both tables show differences that are highly significant statistically. The tables show for both approaches a very large increase in the percentage of drivers stopping. The decision as to whether a vehicle stops is somewhat arbitrary, involving judgement, but for most arriving vehicles this observer was told by the radar operator, via walkie talkie, whether the vehicle stopped. Therefore

Table 14. Chi-square analysis of stopping zone, levels 1, 2 and 3

EASTBOUND

Zone, ft	Percent of Vehicles in Zone Level 1	Level 2	Level 3	Chi-Square	Signif. at 90%	Prob. of Error[a] Less Than
0-10	18.0	9.5	24.3			
11-20	39.6	28.9	60.4	313.3	Yes	0
Over 20	3.7	5.6	9.8			
No Stop	38.7	56.1	5.4			

WESTBOUND

Zone, ft	Level 1	Level 2	Level 3	Chi-Square	Signif. at 90%	Prob. of Error[a] Less Than
0-10	7.7	3.6	10.4			
11-20	14.4	12.2	51.3	368.6	Yes	0
Over 20	6.8	6.7	25.7			
No Stop	71.2	77.5	12.6			

[a] Type I error

Table 15. Chi-square analysis of motorists stopping, levels 1, 2 and 3

EASTBOUND

	Percent Stopping	Of Those Stopping, Percent Stopping <10' From Track
Level 1	61.3	29.4
Level 2	43.9	21.5
Level 3	94.6	25.7

Chi-square = 297.1 with 2 d.f. Significance = 0 for Percent Stopping

WESTBOUND

	Percent Stopping	Of Those Stopping, Percent Stopping <10' From Track
Level 1	28.8	26.7
Level 2	22.5	16.1
Level 3	87.4	11.9

Chi-Square = 342.9 with 2 d.f. Significance = 0 for Percent Stopping these data will be accurate unless the observer is overwhelmed by several vehicles arriving just seconds apart. The zones of stopping were well identified by markers, so the results should not vary greatly from observer to observer. Table 14 includes non-stopping vehicles, so it is difficult to judge the improvement in the stopping zone from these percentages. Table 15 clarifies this by considering only those stopping.

Conclusion: For both the eastbound and westbound vehicles the percent of vehicles stopping increased dramatically after the installation of the Positive Guidance solution. The location of stop improved appreciably for the westbound flow, but stayed about the same for the eastbound movement.

Speed Profiles. Tapeswitch data for level 3 were collected typically from 7:00 a.m. to 6:00 p.m. on two weekdays, a Saturday and a Sunday, just the same as the other types of data. Table 16 shows the eighty-fifth percentile speeds obtained each day at each location on the two approaches. It is apparent without a statistical analysis that there is no appreciable difference from day to day. The eastbound traffic averaged 305 vehicles per day and the westbound was 285.

Table 17 compares the tapeswitch data for levels 1, 2 and 3. It is immediately apparent from the data that there are no differences to speak of among the three levels. The speed profiles did not change appreciably from one level to another.

The pairs of tapeswitches 10 feet from the tracks on the eastbound and westbound approaches showed that the eighty-fifth percentile speeds held steady at about 11.5 and 14 mph, respectively, during the course of the project. This does not necessarily mean that driver performance did not change much in the vicinity of the track as levels 2 and 3 were implemented. For example, consider the level 1 driver who might have slowed to 11 mph by the time he or she reached the last pair of tape-

Table 16. Speeds from tapeswitch data, Level 3

EASTBOUND

Distance From Track, feet	Eighty-fifth percentile speeds Saturday 11/1/80	Sunday 11/2/80	Monday 11/3/80	Tuesday 11/4/80	Avg.
10	11	12	11	12	11.5
50	20	20	20	21	20.5
100	28	28	28	28	28
200	37	35	37	35	36
300	42	40	>39	40	40
500	>39	41	>39	41	41

WESTBOUND

Distance From Track, feet	Tuesday 10/21/80	Thursday 11/16/80	Monday 10/13/80	Tuesday 10/14/80	Avg.
10	-	14	15	14	14.5
50	21	20	21	18	20
100	28	27	28	27	27.5
200	34	34	34	33	34
300	35	35	35	34	35
500	36	38	38	36	37

Table 17. Speeds from tapeswitch data, levels 1, 2 and 3

EASTBOUND

Distance From Track, feet	85th percentile speeds, avg. of 4 days		
	Level 1	Level 2	Level 3
10	11	12	11.5
50	20	19	20.5
100	28	27.5	28
200	37	36	36
300	40	40	40
500	43.5[a]	43[a]	41[a]

WESTBOUND

Distance From Track, feet	Level 1	Level 2	Level 3
10	13.5	14	14.5
50	19.5	18	20
100	26.5	27	27.5
200	34	33	34
300	35	35	35
500	38	37	37

[a] As footnoted in Table 1, speeds above about 40 mph are not precise.

switches, 10 feet from the track. Possibly the driver continued across the track at that speed, never obeying the STOP sign. We would consider that relatively poor driver performance. Now, this same driver might have been influenced by the level 2 or 3 improvements to slow down to much less than 11 mph by about 20 feet from the tracks, and then to accelerate to 11 mph at the last pair of tapeswitches. The driver's performance has improved, but that is not evident from the tapeswitch data. Therefore, tapeswitch speeds cannot be taken at face value at locations very close to the location where stopping is desired. At these locations, the radar speed meter gives a better indication of driver performance. The tapeswitches, however, are very useful for obtaining speed profiles at distances of 50 or more feet from the track.

Conclusion: The speed profiles determined by tapeswitches did not change from one level to another. The absence of change at the location 10 feet from the track is not conclusive, however.

Lowest Speed of Approach. A concealed observer with a hand-held radar speed meter determined the lowest speed of each vehicle as it approached and crossed the track. Table 18 shows the means of both eastbound and westbound motorists for the three levels of operation. Table 19 indicates that all of the changes shown in Table 18 are highly significant statistically.

Eastbound traffic is the critical flow because of the severe sight-distance restrictions. The results indicate that the mean lowest speed in this direction was not appreciably lower at the end of the project at the start. Westbound vehicles reduced their mean lowest speed by over 3 mph, entirely as a result of upgrading to the MUTCD, according

Table 18. Results of lowest speed on approach, levels 1, 2 and 3

EASTBOUND

	Level 1	Level 2	Level 3
Sample Size	769	1368	857
Mean	5.50 mph	7.34 mph	4.73 mph
Standard Deviation[a]	12.05 mph	16.83 mph	8.12

WESTBOUND

	Level 1	Level 2	Level 3
Sample Size	648	903	668
Mean	10.92 mph	7.47 mph	7.85 mph
Standard Deviation[a]	20.18 mph	13.10 mph	11.2 mph

[a] Distributions of speeds are highly skewed positively, because they are bounded on the lower end at 0 mph. That accounts for the high standard deviations.

Table 19. ANOVA Table for lowest speed on approach

Source	Sum of Squares	Degrees of Freedom	Mean Square	F
Mean Speed	261394.7	1	261394.7	1287 (1)
Approach (EB or WB)	10233.2	1	10233.2	50.39 (2)
Level (1,2 or 3)	2973.5	2	1486.8	7.321 (3)
Interaction (Approach and Level)	6020.5	2	3010.3	14.82 (4)
Error	1057493.9	5207	203.1	-

(1), (2), (4): Probability of a Type I error less than 0.0001.
(3): Probability of a Type I error less than 0.001

to Table 18. Mean speeds are usually not of much interest in projects of this type, as the average driver typically operates his or her vehicle in a safe manner. The following paragraphs analyze the faster drivers.

Tables 20 and 21 examine the speeds of the faster vehicles, which are those more likely to be involved in an accident. After the site was upgraded to meet the MUTCD standards only one eastbound driver, out of the 1,326 observed, slowed to a minimum speed over 25 mph. After the installation of the rumble strips and the additional warning signs (level 3), we observed seven such drivers out of 853 (about two per day). Therefore, the percentage of eastbound drivers slowing to a minimum speed in excess of 25 mph increased eight-fold after the Positive Guidance solution was installed. Possibly these drivers are rebelling against what they may regard as noisy, annoying rumble strips by doing the opposite of what they know the authorities are trying to get them to do. It may be pertinent that about one-half dozen drivers per day, in each direction, were observed to avoid the rumble strips by crossing the centerline into the opposing lane.

It is more difficult to speed on the westbound approach because of the winding alignment. In the evaluation of levels 1 and 2, only one westbound motorist of a total of 1504 slowed to a minimum speed over 25 mph. In level 3 (after the Positive Guidance solution was installed), we observed four such drivers out of a total of 661. There was also a sharp increase in the percentage of drivers in the speed groups of 16 to 20 and 21 to 25 mph, as shown in Table 20.

A speed of 11 mph was found to be the 93rd percentile of the lowest

Table 20. Stratification of lowest approach speeds into speed groups for levels 1, 2 and 3

Tabular entries are the percent of the total observations that fall into each group

EASTBOUND

	Speed Groups in Miles per Hour					
	0.5	6-10	11-15	16-20	21-25	>25
Level 1	66.0	27.0	5.3	0.8	0.8	0.1
Level 2	64.3	29.2	4.8	1.4	0.4	0.1
Level 3	66.7	26.0	5.0	1.1	0.4	0.8

Chi-Square = 16.8 with 10 degrees of freedom. Significance = 0.0784

WESTBOUND

Level 1	39.2	47.0	11.8	1.5	0.3	0.2
Level 2	48.5	37.4	11.3	2.4	0.5	0
Level 3	41.9	36.5	13.9	5.4	1.7	0.6

Chi-Square = 55.9 with 10 degress of freedom. Significance = 0.000

Table 21. Stratification of lowest approach speeds into groups of fast and slow, for levels 1, 2 and 3

EASTBOUND

	Percent of Vehicles	
	Slow <11 mph	Fast >11 mph
Level 1	93.0	7.0
Level 2	93.4	6.6
Level 3	92.7	7.3

Chi-Square = 0.4264 with 2 d.f. Significance = 0.808

WESTBOUND

Level 1	86.2	13.8
Level 2	85.9	14.1
Level 3	78.4	21.6

Chi-Square = 19.83 with 2 d.f. Significance = 0.000

BOTH APPROACHES COMBINED

Level 1	90.0	10.0
Level 2	90.4	9.6
Level 3	86.5	13.5

Chi-Square = 15.92 with 2 d.f. Significance = 0.0003 eastbound approach speeds, and was the 84th percentile of the lowest westbound speeds. It is used in Table 21 as a threshold to separate "fast" and "slow" groups. The table shows that "fast" vehicles on the eastbound approach held at a steady percentage of the total during the project. However, on the westbound approach the "fast" vehicles increased by about 50 percent as a result of the installation of the Positive Guidance solution.

It is possible that the increases in the minimum speeds were due to the repaving of Stanley Road prior to the installation of the Positive Guidance solution. The fresh, black appearance in the vicinity of the crossing might have induced some motorists to maintain a higher speed. If this is what happened, then the only conclusion is that these motorists are more influenced by the smoothness and overall character of the roadway surface than by the traffic control devices. In any event, the Positive Guidance solution did not produce the desired result.

<u>Conclusion:</u> For the eastbound vehicles, the mean of the lowest speeds of approach did not change appreciably, and the "fast" group of drivers, over 11 mph, held steady at only about 7 percent of the stream. However, the truly reckless drivers, crossing at over 25 mph, increased eight fold to almost 1 percent of the total. The "fast" group of westbound drivers increased their proportion of the stream from 14 to 22 percent, and reckless drivers tripled to about one-half percent of the total.

<u>Train Frequency and Direction</u>. Table 22 shows that the number of trains almost doubled after level 2 was implemented but was back to its

Table 22. Train frequency and direction, levels 1, 2 and 3

	Number of Trains		
	Northbound	Southbound	Total
Level 1	13	20	33
Level 2	29	32	61
Level 3	20	14	34

Chi-Square on Train Direction = 2.57 with 2 d.f. Significance = 0.28

original rate after level 3 was installed. This fluctuation shows only that there certainly was no predictability to the train arrivals. Local drivers definitely had no expectancies as to when a train might arrive.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

There were two objectives to this Positive Guidance Demonstration Project. The primary objective was to test the Positive Guidance procedures for applicability to the problem at a highway-railroad grade crossing with restricted sight distance. A secondary goal was to achieve an improvement in traffic operation at this particular site.

The project staff had no difficulty in applying the Positive Guidance procedures. Probably at this simple site the procedures amounted to a degree of "overkill", but most traffic engineers should not find it too time-consuming to work their way logically through a structured check-list. The extra time taken to document all of the activities is rewarded by the assurance that nothing has been overlooked. Agencies plagued with lawsuits should find that time spent documenting Positive Guidance procedures will pay for itself many times over in reduced liability.

The evaluation procedures purposely were more extensive than any operating agency would use, as it was desired to determine which of the procedures is most cost-effective. It is recommended that tapeswitches not be used for this type of work, partly because of the technical complexity of the equipment, partly because of the susceptibility to vandalizing, and partly because misleading results can be obtained from tapeswitches located close to the track (near the desired stopping location). Also, it is recommended that observers not be deployed to determine the percent of motorists stopping and the zone of stop. These judgements are too subjective and raise serious questions of inter-observer repeatability.

It is recommended that evaluations of this type be performed by two observers located as close to the road as possible (that is, not at a side location down the tracks). One observer holds a radar speed meter and records the minimum speed of all oncoming vehicles and as many vehicles moving away from him as convenient. If the meter is the type that blanks out its display at speeds below 3 mph, a definite arrangement should be made to record zero speed for those vehicles. The second observer holds 8-power binoculars (or possibly a 20-power telescope for unusual distances) and observes head movements of oncoming vehicles only. This observer should be instructed to look for a "Fuzzbuster" on the dash and driver head movements indicating reaction to a radar-warning device. If the approach has a sharp turn just before the track, as for instance the eastbound appraoch on Stanley Road, then the observer with the binoculars will be stationed to see vehicles well before they reach the turn. That observer will alert the radar person to the impending arrival of the vehicle.

Stanley Road is used entirely by local motorists who either have an origin or destination on it or who know that it is a convenient short-cut. It may be impossible to change their behavior at the crossing short of installing gates, lights and bells. Our evaluation of the effectiveness of the two levels of improvement was hindered by the necessity of using different individuals at each level and different locations for some of their stations. It was unfortunate that Stanley Road and the crossing itself were repaved in the middle of the project.

The previous section of this report drew conclusions as to the changes in head movements (looking behavior), stopping location and percent stopping, speed profiles determined by tapeswitches, and minimum approach speed determined by radar. Overall, driver performance at the crossing did not improve as a result of the two levels of improvement. In fact, the installation of the rumble strips induced some swerving into the oncoming lane and may have been responsible for an increase in vehicles crossing at reckless speeds.

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Appendix Figure 1. Objectives listing

OBJECTIVES LISTING

PROJECT: Positive Guidance Demonstration

PROJECT NO:

EVALUATOR/DATE: P.S. Parsonson and E. J. Rinalducci
12/1/79

CATEGORY	OBJECTIVE	COMMENTS
ACCIDENT REDUCTION	(1) Prevent accidents	Primary Objective No accidents have been associated with site although potential is there.
TRAFFIC PERFORMANCE IMPROVEMENT	(1) Increase looking behavior.	Secondary Objective Observation indicates not everyone looks in both directions.
	(2) Reduce speed and stop at crossing.	Secondary Objective Observation indicates not everyone reduces speed on stops at crossing.
SYSTEM PERFORMANCE IMPROVEMENT	N/A	N/A

Appendix Figure 2. MOE listing

MOE LISTING

PROJECT: Positive Guidance Demonstration Project

PROJECT NO.:

EVALUATOR/DATE: P.S. Parsonson and E. J. Rinalducci
12/1/79

OBJECTIVE: Prevent accidents

SITUATION: Highway railroad crossing

POTENTIAL TRAFFIC CONTROL DEVICE(S):

Warning sign, Guide sign, Stop sign, Rumble strips

MOE's	EXPOSURE UNIT	COMMENTS
Head turning and looking behavior including direction of looking.	N/A	
Speed Profile	N/A	
Lowest Speed in region of tracks or railroad crossing and	N/A	
Stopping zone	N/A	

Appendix Figure 3 a. MOE definition

MOE DEFINITION
PROJECT: Positive Guidance Demonstration Project PROJECT NO.: EVALUATOR/DATE: P.S. Parsonson and E. J. Rinalducci 12/1/79
MOE: Head Turning and Looking Behavior
OPERATIONAL DEFINITION: Motorist looks and turns head in one/both directions along railraod track.
SKETCH: See Site and Condition Diagrams
DATA COLLECTION METHOD Observational
EQUIPMENT/PERSONNEL REQUIREMENTS: Wide-angle binoculars and hidden observer

3 b.

MOE DEFINITION

PROJECT: Positive Guidance Demonstration

PROJECT NO.:

EVALUATOR/DATE: P.S. Parsonson and E. J. Rinalducci
12/1/79

MOE: Speed Profile

OPERATIONAL DEFINITION:

Speed profile as measured by tapeswitches and microprocessor

SKETCH: See Site and Condition Diagrams

DATA COLLECTION METHOD

EQUIPMENT/PERSONNEL REQUIREMENTS:

(1) Tapeswitches and Microporcessor

(2) Observer to collect microprocessor readout, reset microprocessor, and change batteries after each 12 hour data collection period.

3 d.

MOE DEFINITION	
PROJECT:	Positive Guidance Demonstration
PROJECT NO.:	
EVALUATOR/DATE:	P. S. Parsonson and E. J. Rinalducci 12/1/79
MOE:	Lowest speed on approach
OPERATIONAL DEFINITION:	Lowest speed on approach to tracks as measured by hand-held radar gun.
SKETCH:	See Site and Condition Diagrams
DATA COLLECTION METHOD	Hand-held radar gun
EQUIPMENT/PERSONNEL REQUIREMENTS:	Hand-held radar gun with digital readout. Observer hidden from view of motorists who will operate radar gun.

3 c.

MOE DEFINITION

PROJECT: Positive Guidance Demonstration

PROJECT NO.:

EVALUATOR/DATE: P. S. Parsonson and E. J. Rinalducci
12/1/79

MOE: Stopping zone (0-10, 10-20, > 20 ft, No Stop)

OPERATIONAL DEFINITION:

Observation of cars which come to a stop (1 - 2 mph or less) within three distance zones from railroad tracks plus a no stop category.

SKETCH: See Site and Condition Diagrams

DATA COLLECTION METHOD Observational

EQUIPMENT/PERSONNEL REQUIREMENTS:

Wide-angle binoculars

Observer with 20/20 vision either corrected or uncorrected

Appendix Figure 4. Before conditions

PROJECT:	Positive Guidance Demonstration Project
PROJECT NO.:	
EVALUATOR/DATE:	P. S. Parsonson and E. J. Rinalducci 12/1/79
WEATHER:	Clear and cold
SEASON:	Winter
ILLUMINATION:	Daylight
PAVEMENT:	Dry
DAY(S) OF WEEK:	Tuesday, Thursday, Saturday, and Sunday
TIME(S) OF DAY:	7 a.m. to 7 p.m.
VOLUME:	Approximately 300 vehicles per day on weekdays, 200 per day on weekends.
VEHICLE MIX:	Approximately 95% cars, 3% trucks, 2% other
DRIVER MIX:	Mostly local (90%)
OTHERS:	

Appendix Figure 5. Acclimation period

PROJECT: Positive Guidance Demonstration Project

PROJECT NO.:

EVALUATOR/DATE: P. S. Parsonson and E. J. Rinalducci
12/1/79

ESTIMATED START OF ACCLIMATION PERIOD:

MOE CATEGORIES:

- [x] ACCIDENT REDUCTION
- [x] TRAFFIC/SYSTEM PERFORMANCE

ACCLIMATION PERIOD(S):

- [ ] 3 YEARS WITH EVALUATION AFTER 1ST AND 2ND YEAR
- [ ] 1 YEAR
- [x] OTHER: 4 - 5 WEEKS

POSSIBLE CHANGES OVER TIME	CONTROLS
New signs	acclimation period of 4 - 5 weeks
Other traffic devices	acclimation period of 4 - 5 weeks

Appendix Figure 6. Evaluation design

EVALUATION DESIGN

PROJECT: Positive Guidance Demonstration

PROJECT NO.: P. S. Parsonson and E. J. Rinalducci
12/1/79

EVALUATOR/DATE:

DESIGN:

- [x] BEFORE-AFTER
- [ ] BEFORE-AFTER WITH A CONTROL SITE

FOR BEFORE-AFTER WITH A CONTROL SITE DESIGN, IDENTIFY CONTROL SITE(S):

COMMENTS:

Appendix Figure 7.a. Statistical Tests

STATISTICAL TESTS

PROJECT: Positive Guidance Demonstration

PROJECT NO.:

EVALUATOR/DATE: P. S. Parsonson and E. J. Rinalducci
12/1/79

MOE: Head Turning (or looking)

TEST: Chi - Square

COMMENTS: At this site, looking and head-turning may be assumed to be one and the same.

MOE: Lowest speed on approach

TEST: t - Test or ANOVA

COMMENTS: Measured via hand-held radar gun

MOE: Stopping zone (0-10, 10-20, > 20 ft, no stop)

TEST: Chi - Square

COMMENTS:

Appendix Figure 7.b.

STATISTICAL TESTS
PROJECT: Positive Guidance Demonstration PROJECT NO.: EVALUATOR/DATE: P. S. Parsonson and E. J. Rinalducci 12/1/79
MOE: Speed Profile TEST: Chi - Square COMMENTS: Measured via tapeswitch and microprocessor
MOE: TEST: COMMENTS:
MOE: TEST: COMMENTS:

Appendix Figure 8.

LEVEL OF SIGNIFICANCE
PROJECT: Positive Guidance Demonstration **PROJECT NO.:** **EVALUATION/DATE:** P. S. Parsonson and E. J. Rinalducci 12/1/79
LEVEL OF SIGNIFICANCE ☐ .20 (80%) ☐ .10 (90%) ☒ .05 (95%) ☐ ______Other (Specify)
COMMENTS:

Appendix Figure 9 a.

SAMPLING PLAN

PROJECT: Positive Guidance Demonstration

PROJECT NO.:

EVALUATION/DATE: P. S. Parsonson and E. J. Rinalducci
12/1/79

MOE: Head turning/looking

MINIMUM SAMPLE SIZE: 4 days per approach

SAMPLING PLAN: All sampling is by time intervals - Tuesday, Thursday, Saturday, and Sunday 7 a.m. - 7 p.m.

MOE: Lowest speed on approach

MINIMUM SAMPLE SIZE: 4 days per approach

SAMPLING PLAN:

See above

MOE: Stopping zone

MINIMUM SAMPLE SIZE: 4 days per approach

SAMPLING PLAN:
See above

Appendix Figure 9 b.

SAMPLING PLAN

PROJECT: Positive Guidance Demonstration

PROJECT NO.:

EVALUATION/DATE: P. S. Parsonson and E. J. Rinalducci
12/1/79

MOE: Speed profile

MINIMUM SAMPLE SIZE: N/A

SAMPLING PLAN: Tapeswitch recording all cars sampled between 7 a.m. - 7 p.m. on Tuesday, Thursday, Saturday and Sunday.

MOE:

MINIMUM SAMPLE SIZE:

SAMPLING PLAN:

MOE:

MINIMUM SAMPLE SIZE:

SAMPLING PLAN:
See above

Appendix Figure 10.

DATA COLLECTION PLAN AND SCHEDULE	Sheet 1 of 10

PROJECT: Positive Guidance Demonstration

PROJECT NO.:

EVALUATOR/DATE: P. S. Parsonson and E. J. Rinalducci
12/1/79

PROJECT LOCATION: Stanley Rd., Kennesaw, Ga.

CONTROL SITE LOCATION:
N/A

DATE FOR START OF PROJECT: 12/1/79

DATE FOR START OF PRE-BEFORE PHASE: 12/15/79

EQUIPMENT REQUIREMENTS (NOTE TYPE, QUANTITY, AVAILABILITY, SERIAL NO.,)

1 Hand-held radar gun
2 Binoculars
40 Tapeswitches
1 Microprocessor
1 Stopwatch
1 Bolex Movie Camera
1 Minolta 35 mm Camera

All in our possession except replacement parts and supplies

DATES FOR PROCUREMENT N/A OR ASSEMBLY

CALIBRATION AND COMPARABILITY CHECKS

Weekly calibration of Radar Gun

DATES FOR CALIBRATION: Ongoing

DATES FOR COMPARABILITY CHECK: Ongoing

Appendix Figure 10 - 2

DATA COLLECTION PLAN AND SCHEDULE	PROJECT NO.	Sheet 2

PERSONNEL REQUIREMENTS (NOTE FUNCTIONS, INDIVIDUALS, AVAILABILITY)

At site during data collection:

2 Binoculars Men

1 Radar Man

1 Relief

1 Driver

All available

Office Personnel:

2 Data technicians

DATES FOR RECRUITMENT: 12/1 - 12/15

DATES FOR ASSIGNMENT: 12/15 - 12/20

TRAINING REQUIREMENTS:

For field personnel, one day's training in field. For office personnel, training as required.

DATES FOR TRAINING: 12/20

FORM REQUIREMENTS (NOTE FORMS, AVAILABILITY)

4 field data collection forms.

DATES FOR PROCUREMENT/ASSEMBLY 12/1 - 12/15

DATES FOR DESIGN: 12/1 - 12/15
TESTING: 12/15 - 12/20
PRODUCTION: 12/20 - 12/25

Appendix Figure 10 - 3

<table>
<tr><td>DATA COLLECTION PLAN AND SCHEDULE</td><td>PROJECT NO.</td><td>Sheet 3</td></tr>
<tr><td colspan="3">COORDINATION (DESCRIBE REQUIREMENTS)

Liaison with State DOT - Don Mills
Organizational meetings with all personnel.</td></tr>
<tr><td colspan="3">DATES FOR COORDINATION - 1/1/80 - 1/15/80</td></tr>
<tr><td colspan="3">DATA COLLECTION PROCEDURES, EQUIPMENT, LOCATION AND PERSONNEL LOCATION AND PROCEDURES:

See above.</td></tr>
</table>

Appendix Figure 10 - 4

DATA COLLECTION PLAN AND SCHEDULE	PROJECT NO.	Sheet 4

PILOT TESTING (INDICATE DETAILS)

Will spend several days in the field testing equipment and observation locations.

DATE(S) FOR PILOT TESTING START 12/15

FINISH 12/20

DATE FOR START OF BEFORE DATA COLLECTION 1/15/80

DATE FOR FINISH OF BEFORE DATA COLLECTION 2/15/80

CONTINGENCY PLANS:

Finish date is flexible - can be postponed if necessary.

Appendix Figure 10 - 5

DATA COLLECTION PLAN AND SCHEDULES	PROJECT NO.	Sheet 5
DATA COLLECTION CONDITIONS (TIME OF DAY, DAY OF WEEK, ENVIRONMENTAL, ETC.) 7 a.m. - 7 p.m. Tuesdays, Thurdays, Saturdays and Sundays		
SAMPLE SIZE(S) See below		
SAMPLING TECHNIQUE(S) Time sample		
DATA ASSESSMENT (RESULTS OF DATA COLLECTION, REDUCTION OF DATA) Data will be punched onto computer cards, evaluated using packaged programs.		
DATES FOR DATA ASSESSMENT Ongoing		

Appendix Figure 10 - 6

DATA COLLECTION PLAN AND SCHEDULE	PROJECT NO.	Sheet 6

DATE FOR APPLICATION OF IMPROVEMENT
2/15/80

SURVEILLANCE AND CONTROLS DURING ACCLIMATION PERIOD

None

DATE FOR START OF PRE-AFTER PHASE

EQUIPMENT REQUIREMENTS (NOTE TYPE, QUANTITY, AVAILABILITY, SERIAL NO.)

Same as above

DATES FOR PROCUREMENT ____________ OR ASSEMBLY ____________

CALIBRATION AND COMPARABILITY CHECKS

Same as Above

DATES FOR CALIBRATION: Ongoing

DATES FOR COMPARABILITY CHECK: Ongoing

Appendix Figure 10 - 7

DATA COLLECTION PLAN AND SCHEDULE	PROJECT NO.	Sheet 7

PERSONNEL REQUIREMENTS (NOTE FUNCTIONS, INDIVIDUALS, AVAILABILITY.)

Same as above

DATES FOR RECRUITMENT: N/A

DATES FOR ASSIGNMENT: N/A

TRAINING REQUIREMENTS:

Same as above

DATES FOR TRAINING: N/A

FORM REQUIREMENTS (NOTE FORMS, AVAILABILITY)

Same as above

DATES FOR PROCUREMENT/ASSEMBLY: N/A

DATES FOR DESIGN:
TESTING: N/A
PRODUCTION:

Appendix Figure 11.

DAILY LOG	
PROJECT:	Positive Guidance Demonstrations
PROJECT NO.:	
EVALUATOR/DATE:	P. S. Parsonson and E. J. Rinalducci 12/1/79 and ongoing
DATA COLLECTION PERSONNEL:	
TIME	CONDITIONS, EVENTS OR DEVIATIONS

Appendix Figure 12.

ACCIDENT SUMMARY TABLE

PROJECT: Positive Guidance Demonstration

PROJECT NO.:

EVALUATOR/DATE: P. S. Parsonson and E. J. Rinalducci
12/1/79 - 1/15/79

DATA SOURCE: Police Records

TIME PERIOD 1975 TO 1980

LOCATION [X] PROJECT SITE
[ ] CONTROL SITE

[X] BEFORE
[ ] AFTER

TYPE OF ACCIDENT	NUMBER OF ACCIDENTS: PDO	INJURY	FATALITY	TOTAL
There have been no accidents at this site.				
TOTALS				

Appendix Figure 13.

TRAFFIC VOLUME SUMMARY TABLE

PROJECT: Positive Guidance Demonstration

PROJECT NO.:

EVALUATOR/DATE: P.S. Parsonson and E. J. Rinalducci 12/1/79

DATA SOURCE: Observation - Stopping Zone

TIME PERIOD __________ TO __________

LOCATION [X] PROJECT SITE [ ] CONTROL SITE

[X] BEFORE

[ ] AFTER

TIME PERIOD	AADT	AVERAGE
1806	vehicles	daily average 225

Appendix Figure 14.

ACCIDENT MOE DATA SUMMARY

PROJECT: Positive Guidance Demonstration

PROJECT NO.:

EVALUATOR/DATE: P. S. Parsonson and E. J. Rinalducci
12/1/79

EVALUATION PLAN: [X] BEFORE/AFTER [ ] CONTROL SITE

BEFORE PERIOD: 1/15/80 TO 2/15/80 ; AFTER PERIOD Current TO ____

MOE DATA	BEFORE (PROJECT)	BEFORE (CONTROL)	AFTER (PROJECT)	AFTER (CONTROL)
Accident units: Total Accidents	None			
Severity units: Fatal Accidents Injury Accidents PDO Accidents	N/A			
Exposure units: ___V, or _____VM AADT	N/A			
Exposure Rates Total Accidents/ Fatal Accidents/ Injury Accidents/ PDO Accidents/	N/A			